THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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THE GUERNSEY TELEPHONE SYSTEM.

IN several journals the statement has recently been made that the average capital cost of the States of Guernsey telephone system worked out, according to the latest yearly statement, at £17 9s. 5d. per working line. In order to test this statement, we have examined the report and compared the accounts with the very complete statistics appended thereto.

The accounts of the Guernsey States Telephone Department for the year ending December 31st, 1903, show a total capital investment of £24,467 9s. 8d., made up as follows:—

Land and buildings...	£2,321 18 11
Works	21,262 4 2
Stores...	651 15 11
Tools	114 12 6
Stationery	12 0 3
Office furniture	104 17 11
	£24,467 9 8

The total number of instruments in use was 1,217, made up as follows:—

Subscribers' lines	1,044
Extension	91
Private lines	19
Public telephones	40
Sundry lines	16
Service lines	6
Free line	1
	1,217

In bringing out the average capital cost at £17 9s. 5d.—a figure which, in some of the technical journals, is said to be the cost per working line—the total number of instruments, 1,217, is divided into the amount for works completed and in course of construction alone, viz., £21,262 4s. 2d. The rest of the capital expenditure is left out of account, and the instrument is used as the unit of cost instead of the line. There seems to be no justification for leaving out of account, in calculating the average cost per subscriber, the amount of £2,321 18s. 11d. for land and buildings, as, in the expense account, the only charge for rent is one of £56 14s. 11d., which covers rent, rates, gas, and insurance. As there are eight switchrooms, the amount of £56 14s. 11d. for rent, rates, gas, and insurance, cannot cover a proper charge for rent on the land and buildings which have cost £2,321 18s. 11d. If no charge is made in the working expenses on this, the amount ought properly to go into the capital account. The other items of capital expenditure, such as stores, tools, &c., should also properly be included in the total capital, as there must always be capital invested in such supplies. The total capital should, therefore, properly be taken at £24,467 9s. 8d. The actual working lines are 1,084, deducting extensions, private lines, and the service and sundry lines. A certain number of service and sundry lines must always exist in any system, and are a necessary part of the facilities for

managing the system. They should not be taken into account in averaging the capital cost of the revenue-earning part of the system. The extension stations, 91, may be taken at an average capital cost of £5 each, and the private lines are liberally estimated at £10 per station. This gives £645 for the value of the extension and private line stations. Deducting this from £24,467 9s. 8d., we get £23,822 9s. 8d., which, divided by 1,084, gives £22 average capital cost per working line. If the cost of the land and buildings is eliminated from the capital cost, the average capital cost per working line is £19 17s. Before the 1898 Select Committee on Telephones, Mr. A. R. Bennett said, in reply to a question as to exactly what had been done in Guernsey and what was the cost per subscriber, "As it is not yet quite completed I cannot tell you what the capital charge is, but the estimated capital cost was between £13 and £14 per subscriber, and we have every reason to believe that the cost will be kept within those limits."

The Guernsey States Telephone Department puts by a depreciation and sinking fund of 5 per cent. on the construction account. The plant is very largely overhead, there being 827 miles of overhead metallic circuit to 318 miles of underground metallic circuit, and the poles and roof fixtures in the centre of the town are much overloaded. The method of working is the ring-through system, so that the central office and subscribers' equipment are of an antiquated description. Under these circumstances a larger depreciation fund should be established, as a good deal of the plant will probably have to be reconstructed before very long. The net profit of £201 12s. 6d. would be turned into a loss of over £300, if the depreciation fund were 7½ per cent. instead of 5 per cent.

The noticeable feature of the Guernsey system is that the service is hardly used at all. The total daily traffic is only 2,113 calls per day, giving an average traffic of 1·9 calls per subscriber daily. No doubt the Guernsey system serves the purpose of the Guernsey population, as the life is quiet and a relatively inferior service is probably able to cope with the very small traffic. The general management of the system is conducted by a Council of gentlemen of good standing, who give their time and labour gratuitously, and as wages and the cost of living are very low in Guernsey, there is no reason why such a simple service should not be operated very economically. No fair comparison, however, can be made between the Guernsey telephone conditions and those of a British city, as almost all the factors in the two cases are entirely different.

Ostwald's Faraday.

In his Faraday lecture, delivered before the Chemical Society on April 19th, Prof. Ostwald, of Leipzig, pointed out that, though Mayer and Joule at a later date gave the first quantitative demonstration of the law of the conservation of energy, the whole of Faraday's writings were permeated with the idea that when energy disappeared in one form it must reappear in another form. The splendid work done by Prof. Ostwald in the application of the theory of energy to chemical reactions, imparts a special interest to his views on the recent discovery of the disintegration of the atoms of radioactive elements. In regard to the nature of the elements, he said that their differences were connected with their specific energy-content. He represented the elements by a cavern full of hanging stalactites. The end of each stalactite representing an element, it was not possible to pass from one to another except by going over the passes separating each from its neighbour, and this could only be done by accumulating an appropriate amount of energy in the element to be changed. The transmutation of radium into helium might conceivably be explained by supposing that in the corner of the cavern, where the elements of the highest combining weights were assembled, the stalactites were very short—in fact, not really stalactites, but rather regions of different slope in the sloping ceiling. A drop of water might be taken as furnishing a picture of the stability of the elements. Hanging at the end of a true stalactite it would require work to be done before it would rise over the pass and flow down another stalactite; but in this corner it would flow of its own accord and only delay on the nearly horizontal portions of the ceiling. Enormous amounts of energy being required for the transmutation of one element into another, enormous amounts would also be liberated if an unstable one changed into a stable one; and the fact that radium changes into helium, an element with an exceptionally long stalactite, leads one to expect the development of the large amount of energy which has been found to be liberated.

Electrical Power on Board Ship.

A recent paper read before the Institute of Marine Engineers, on the application of electric power on cargo steamers, is well worthy of a much wider consideration than it appears to have received. Modern shipbuilding demonstrates the fact that greater attention is now being paid to the development of the vessel in its true capacity—*i.e.*, as a floating temporary receptacle for merchandise, suitably equipped for the rapid handling of the goods contained therein.

With the art of shipbuilding we are not concerned, but in the matter of handling the cargo, and operating the major portion of the auxiliary machinery found below deck, it appears to us that the electrical engineer is vitally concerned.

Cargo steamers are subjected to very rough usage and to very severe strains; the structural distortion due to bad weather and other causes necessitates exceptional construction. It is, therefore, not surprising that, under these circumstances, shipowners in years gone by should have fought shy of electrical apparatus *en masse*, when they could only turn to land practice for guidance. We think that the time has now arrived, however, for giving the electrical engineer a chance to demonstrate his abilities. Surely the past 10 years' experience in power applications in mines, quarries, mills, tramways, railways, &c., is sufficient to convince any ordinary individual as to the abnormal treatment and unskilled usage which motors have successfully withstood.

The tendency of the present day, as mentioned by the author of the paper, is to multiply cargo-handling appliances *ad libitum*. He referred to a ship of 11,000 tons D.W. capacity, provided with five hatches and 10 winches, and we can add a vessel of 10,300 tons cargo-carrying capacity, provided with 12 hatches and 24 winches, which was designed to discharge its full cargo within a period of 30 hours. This is probably an exceptional case, but it well illustrates the trend of modern shipbuilding.

Now, although steam winches and auxiliaries, with all their drawbacks of deck pipe condensation and possible freezing, exhaust steam nuisances, &c., have served their purpose in the smaller ships of past years, it becomes a matter for serious consideration, whether in the case of a modern cargo carrier with as many as two dozen winches, eating steam at anything from 150 to 200 lbs. per H.P.-hour, the highly efficient electric motor and transmission shall not displace its extravagantly wasteful rivals.

In the engine room auxiliary plant also, with its numerous little high-speed engines, the electrical engineer can show an improvement in present efficiency, and with all this, if the experiences of the builders of the White Star liner *Baltic*, who estimated a saving of 10 per cent. in the machinery spaces through the adoption of electrical equipment, are repeated, the ship owner obtains a decided gain in the carrying capacity of his vessel, an argument which will, perhaps, appeal to him more forcibly than any other.

THE PRESENT POSSIBILITIES OF THE GAS PRODUCER AND GAS ENGINE FOR CENTRAL STATION PURPOSES.

It may be taken as a generally accepted principle that the main consideration in regard to any process of generating electrical energy is the question of cost. Electric generators and accessories have reached an almost irreducible minimum in this respect, so that the search is now for a reduction in the cost of the prime mover.

The present available sources of power and heat may be tabulated as follows :—

1. Water-power, due to head and quantity.
2. Natural gas combustion with air.
3. Carbon and hydro-carbons on combustion with air.

For the purposes of this article we will leave out of consideration the first two sources of power and heat, because in this country the power available from water is very limited, and the same may be said of natural gas.

The source of heat under the third head may be further sub-divided thus :—(1) Bituminous coal ; (2) anthracite ; (3) coke ; (4) oil.

The most abundant and cheapest source of power available in this country is bituminous coal, and it is most largely distributed. Anthracite is not so abundant, and the cost of carriage to places distant from its source very seriously affects its possibilities of economical application.

Coke, consisting as it does of bituminous coal after it has undergone a more or less costly operation which has removed a certain portion of its heat value, must, of course, rank as a more expensive source of heat than the original coal.

In regard to oil fuel, though the oil engine has reached a high point of efficiency, the supply of this class of fuel is not sufficiently large in this country to allow of its competing in the matter of cost with either anthracite or coke, not to speak of common coal.

From economical considerations, then, we must turn to bituminous coal as the cheapest original source of heat and power, and the next question must be how to most cheaply convert its stored-up heat into electrical energy.

The better qualities of bituminous coal have, up to the present, been the chief source of heat for the production of electrical energy through the agency of the steam boiler and engine, giving under different conditions efficiencies generally not higher than about 8 to 10 per cent.

Gas producers and gas engines are capable of giving a much higher efficiency, amounting under ordinary working conditions to from 13 to 20 per cent. ; but this brings in the further consideration of the cost of the fuel used in the gas producer, compared with that used in larger quantity under steam boilers in the locality under consideration.

The most important points in regard to gas producers are : (1) The fuel should be low in cost ; (2) The quality of the gas must be constant ; (3) Tarry matter must be perfectly removed from the gas, either in the producer itself or in associated apparatus.

The gas engine has frequently had to bear blame for negligence in the cleansing of the gas from tar, &c. Given clean gas of regular quality, even of low thermal value, there should be no trouble from *premature ignition*, or *firing in the exhaust*, two very serious sources of nuisance.

The application of gas of low thermal value had done more to increase the gas engine unit than has the advance in gas producer practice ; the successful application of blast furnace waste gas to driving gas engines of large power units has shown that the poorest class of air gas does not require enriching, and that the presence of a high proportion of hydrogen in the gas is a disadvantage rather than otherwise.

Our contemporary, the *Electrical World and Engineer*, of New York, gives an abstract of a paper read by Mr. Ralph D. Mershon, before the New York Electrical Society, on "The Gas Engine for Central Station Service," which contains many points of interest. Mr. Mershon has visited most of the large gas engine installations in America and other countries, and, therefore, his remarks are the more valuable. Dealing with the question of governing, he points out the defects of the hit-or-miss method when cyclic irregularity is to be reduced to that necessary for running electrical generators ; this point is generally recognised by gas engine makers, and the method of governing by reducing the charge, is almost universally adopted, as much more regular running can be effected without excessive fly-wheel weight.

Mr. Mershon describes a typical gas producer, shown in fig. 1, which we reproduce from the *Electrical World and Engineer* ; the illustration requires little explanation, but we may point out that it is for use with anthracite or coke. The producers for using bituminous coal require a somewhat different method of construction, the main endeavour being to cause the volatile gases to traverse the highly heated zone

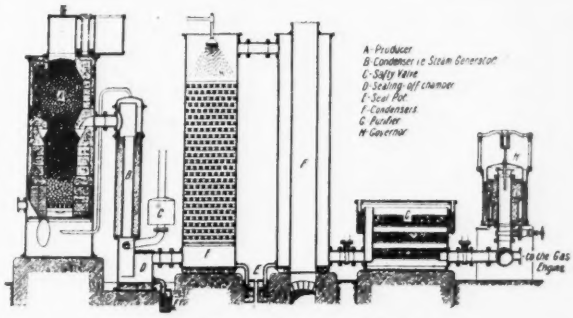


Fig. 1.—Gas Generator.

of the producer, so as to render the gases permanent, but most of them depend for their success on a complete washing out of all tar products after the gas leaves the producer, though some producers so far accomplish the fixing of the tar as to only require a minimum of scrubbing apparatus. Mr. Mershon stated that the cost of the gas engine is considerably in excess of that of the steam engine, and as compared with the steam turbine the discrepancy is even greater.

Mr. J. R. Bibbins* says in this connection :—"In cost the gas engine equipment is quite comparable with that of a steam plant. The engine itself costs more than a steam engine of corresponding size, on account of the increase in metal required by the higher pressures dealt with. With the cost of condensing machinery charged to the steam engine, however, this disparity is much reduced. In the case of a producer gas plant installed to supply gas engines, the cost of the respective equipments, each of 1,000 H.P., is at parity."

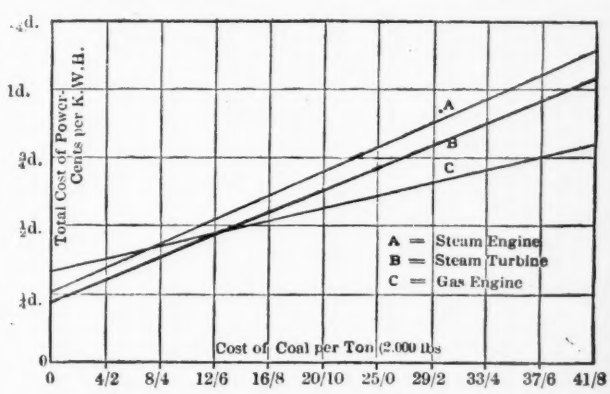


Fig. 2.—Comparative Curves.

Mr. Mershon refers to the overload capacity of steam engines and turbines, compared with that of the gas engine, but gas engines should not be run up to their maximum, because an increase of load would result in a slowing down and stoppage ; while with gas of low thermal value, there is a considerable range in the mean pressure which can be regulated by the governor, owing to the gas being able to give a good mean pressure without involving a high maximum pressure.

Fig. 2, which we also reproduce, shows comparative curves of cost of energy for steam engines, steam turbines, and gas engines, prepared by Mr. Mershon, after making all necessary allowances

* "Gas Power for Central Stations," American Institute of Electrical Engineers, New York, December, 1903.

for first cost of the plants compared, cost of maintenance, attendance, coal, &c., assuming in each case that energy is to be supplied to a load having a load factor of 0·5, that the peak load is 1,500 KW., and that a steam pressure of 150 lbs. is to be used, superheated to 150° F. Under these conditions the following figures for performance are obtained, being such as will be guaranteed by the makers:—Steam engine, 12 lbs. per B.H.P.-hour; steam turbine, 18 lbs. per KW.-hour; gas engine, 10,000 B.Th.U. per B.H.P.

It is to be understood that the curves include everything properly chargeable against the cost of power, including interest, depreciation and renewals on the whole installation and supplies, labour and fuel. The line A shows the cost for a steam engine plant, B for a steam turbine plant, and C for a gas engine plant.

The point at which the line C crosses the other two lines shows the cost of fuel at which the gas engine plant is on a parity with the steam engine plant, and the steam turbine, respectively, the steam engine using coal costing 7s. 8½d. per ton of 2,000 lbs., and the steam turbine set coal at 12s. 6d. per ton.

Mr. Mershon goes on to say that the curves show the relative performance of the plants under the assumed conditions pretty fairly, no matter what modifications might be made in the estimates, and that, for a load factor over ·5, the gas engine would make a much better showing.

Where the value of the fuel approaches zero, as for plants installed at coal mines for the generation of power, a steam turbine, and not a gas engine, should be used, unless for such a large installation as would merit the recovery of bye-products.

The indications are all in the direction of employing fuel in a gaseous form directly in the cylinders of internal combustion engines, and the successful advance in the gas producer for converting common qualities of coal slack into gas, free from tarry matter, will be the most important factor in the application of gas engines to central station service.

WRONGFUL DISMISSAL.

[BY OUR LEGAL CONTRIBUTOR.]

CERTAIN questions which were recently addressed to us for consideration in our "Legal Query" column, seem to show that difficulties sometimes arise in connection with the commencement and termination of contracts of employment of central station engineers. Many companies and corporations who supply electric light have stereotyped forms of contract which they require their employés to sign; but cases sometimes occur in which unlooked for circumstances arise which render the termination of the contract a matter of difficulty. Again, the central station engineer may wish to know his exact legal position if he desire to terminate his present contract and accept a better post elsewhere, and his legal position is not always clear even when the matter is put into writing. There is one other circumstance which renders it desirable for the engineer to have his position as clearly defined as possible. He has constantly to deal with a municipal corporation or a local authority who, under the plea of protecting the ratepayers, claim to take their stand upon legal rights, and show very little of the milk of human kindness in dealing with their employés. In these circumstances it may be convenient to consider some of the legal requirements of the commencement and termination of a contract.

The first question of importance which may arise, is whether the contract is to be reduced into writing or not? Every prudent man will have his contract of service put into writing; but in some cases a station engineer is tempted to rely upon the honour and integrity of those who employ him. He should know, however, that there are certain contracts of employment which cannot be enforced unless the terms are reduced into writing.

Thus it is provided by the Statute of Frauds that no action shall be brought upon any agreement that is not to be performed within the space of one year from the making thereof, unless the agreement upon which such action shall be brought, or some memorandum or note thereof shall be in writing and signed by the party to be charged therewith or some other person thereunto by him lawfully authorised.

The following agreements have been held to come within this provision:—An agreement for service to last more than a year defeasible by three months' notice on either side; an agreement for life, subject to its being determined by death, or retirement, or misconduct; and an agreement not to set up a certain trade during the joint lives of the parties to it; but it may be doubted how far the last two instances are sound in view of the decisions previously referred to.

Notice.—The next question to consider is the length of notice which must be given in order to terminate a contract of service. When the hiring is a yearly hiring, it cannot in general be put an end to by either party before the end of the year. If, therefore, on the one hand, a master wrongfully dismiss his servant during the year, the servant may maintain an action against him for such wrongful dismissal, and a jury would in some cases be justified in assessing his damages at the amount of wages which he would have earned had he been allowed to serve at the end of the year.

In the case of Down *v.* Pinto, 9 Ex. 327, where the defendant having established smelting works at Carthagena, in Spain, offered to employ the plaintiff as foreman, by letter, containing the following passages: "I should require you to enter into an engagement to remain with me for at least *three years at my option*, salary £250 per annum." It was held that this did not enable the defendant to put an end to the service at his will, but that it was a yearly hiring with an option for the defendant to require the plaintiff's services for three years, or to put an end to it at the expiration of the first, second, or third year.

The foregoing rule, however, is subject to an exception in some cases of service of the Crown, and in cases in which the agreement of hiring is subject to some stipulation, either express or implied by custom, evidence of which is in all cases admissible, if not inconsistent, with the contract enabling either party to determine the contract by notice. In such cases if the contract is determined by a notice, in accordance with the custom, the servant is entitled to recover wages for the fractional portion of the year during which he has served.

It is clear, notwithstanding a notion to the contrary, which, not uncommon, that a yearly servant wrongfully quitting his master's service forfeits all claim to wages for that part of the current year during which he has served, and cannot, after having wilfully violated the contract according to which he was hired, claim the sum to which his wages would have amounted had he kept his contract, merely deducting therefrom one month's wages.

This, at first sight, may appear rather harsh to some; but it is believed to be not only the law, but far more consistent with common sense than to allow a man, at one and the same moment, to break a contract and claim a benefit under it, especially when, upon merely giving notice to his master, and paying (or agreeing to allow his master to deduct the amount due to him) a month's wages, he could leave at any time; and the practical effect of adhering to the strict letter of the law is merely to compel the servant to give his master notice when he wants to leave, which can be but little trouble to him, and will in most cases save the master a great deal of unnecessary inconvenience and trouble, and sometimes loss.

It is difficult to lay down any broad rule as to the causes which will justify summary dismissal without notice, or wages in lieu of notice. In the case of Callo *v.* Brouncker (4 C. & P. 518) it was asserted that to justify a master in dismissing a yearly servant before the expiration of the year, there must be on the part of the servant either moral misconduct, or, otherwise, wilful disobedience or habitual neglect. Numerous instances might be quoted; but in the majority of cases the point is raised as a simple issue of fact for a jury to take an illustration. In Smith *v.* Thompson (8 C.B. 44), a man was engaged as a clerk under a contract of hiring for two years, to conduct the business of a shipping agent at Southampton. In the course of such employment it was the duty of the clerk to pay freight, dock dues, &c.,

to meet which the employer from time to time forwarded the necessary funds. The clerk wrote to his employer for £140, enclosing an account of the purpose for which it was required, one of them being the payment of £30 for salary due to himself. Ten days afterwards the employer forwarded a cheque for £100, with a letter, directing him to apply the money for business purposes. The clerk having appropriated £30 of the money in satisfaction of his salary, he was discharged. In an action for wrongful dismissal, the employer justified his conduct, saying that the plaintiff had wrongfully and improperly misappropriated the money remitted. The judge left it to the jury to say whether the plaintiff had been guilty of any wrongful and improper misappropriation of the moneys entrusted to him by the defendant, or of any wrongful or improper disobedience of orders. This was held to be a proper direction, but the report does not say whether the plaintiff was successful or no.

There are no cases in the books in which the conduct of a station engineer has been called in question, but it is presumed that any negligence on his part which might lead to the cessation of the supply would afford good ground for dismissal. Under this head, absence without leave would probably justify discharge without salary, or salary in lieu of notice.

THE CONTINUOUS-CURRENT SYSTEM AND THE SINGLE-PHASE SYSTEM FOR TRACTION.

By H. M. HOBART.

Hundreds of thousands of continuous-current railway motors are now in use, and are giving excellent satisfaction. The field of operation for electric traction has been rapidly extended, and it has encroached heavily upon the suburban and interurban traffic heretofore handled exclusively by the main steam lines.

The replacement of steam by electric traction on main lines is still of doubtful economic practicability, although much attention has been given to the subject.

The economic impracticability of operating main lines electrically has related chiefly to the difficulty of obtaining any approximation to a uniform load, for, providing the traditional limit of 650 volts at the train is accepted, the sub-stations cannot be many miles apart, and at the customary spacing and speed of through trains, a sub-station will be alternately running idle for long intervals and loaded for short intervals. Several times more capacity of sub-station apparatus will, therefore, be necessary than would be the case could the same amount of work be done at a uniform rate. Moreover, the average efficiency is excessively low owing to the large constant losses in such a large installation of lightly-loaded machinery. At first sight, the natural solution would appear to be to operate by single cars instead of trains. While this would greatly improve the load factor, it would increase by from 100 per cent. to 200 per cent. the work required to be done per ton hauled a given distance * at a given speed. This would at any rate be the case at speeds above 50 miles per hour. Furthermore, there would inevitably be greater danger and expense in operating at a schedule speed of 60 miles per hour, six carriages at five-minute intervals, as against one train per half hour. Were it not for the enormously increased friction incurred by single-car operation, this would, however, be the plan which would be followed; and it may, to some extent, indicate the lines on which main roads will ultimately be operated.

An increased permissible voltage would permit of fewer, larger, more uniformly loaded and more economical sub-stations situated at greater distances apart.

The possibilities in this direction, as associated with the use of continuous-current motors, have been but little considered. The hopelessness of the case from the standpoint of any such low voltage as 650 has generally led to the expectation that some solution by alternating current motors would ultimately be found. A good deal of tentative work with three-phase motors has been carried out during the last few years, but the difficulties associated with two insulated conductors, lack of speed flexibility, and a number of other disadvantages more or less consequent upon the latter, have sufficed to dampen the enthusiasm of many engineers who were originally very sanguine along these lines.

The application of the commutator to the polyphase motor afforded considerable promise of giving it greater speed flexibility. Hardly, however, was this appreciated, before the *single-phase* commutator motor was brought to a commercial stage of development. This naturally concentrated attention upon the problem of the single-phase operation of main line railways, for the single-phase commutator motor not only affords speed flexibility, but also avoids the necessity for two insulated conductors.

It is reasonable to base upon these developments renewed hopes of solving the problem of the electrical operation of main lines. Is it, however, reasonable or just to the continuous-current motor to disregard its undeveloped possibilities, especially in the matter of operation at higher voltage? Aside from the question of main line traction, there is a large field for interurban electric traction and for extensive urban and suburban systems. Doubling or trebling the voltage at the train would at once immensely extend the range of economic working. There are the further possibilities associated with two commutators, or even two motors in series, and treated as a single unit. series-parallel control is well within the range of the practicable at such voltages; indeed, the controller problem is, in some respects, simplified by the reduction of the current through increased voltage. But in high speed suburban and interurban work with infrequent stops, rheostatic control need detract but slightly from the efficiency,* and as it is for just such work that the higher voltages are desirable, the argument would, from the continuous-current motor's standpoint, be but slightly impaired by the assumption of rheostatic control.

It appears the more desirable to speak on behalf of the continuous-current motor in this connection, since, contrary to expectations, it is not so much for main line work, but more especially for urban, suburban, and interurban work, that the single-phase motor is at present being strongly advocated.

Thus Mr. P. M. Lincoln † states:—"Interurban electric traction work is, in my opinion, the peculiar field for the alternating current system." Also, "When stops are few and consequently runs are long . . . . the advantage of the alternating current system is not so greatly marked. With short runs on the other hand, and consequently frequent starts . . . . the alternating current system can have the greater advantage."

Mr. B. G. Lamme states:—"It thus appears that, while suburban work was once thought to be the most important field for the single-phase railway, it has now become evident that city work, where traffic is very congested in parts of the system, will prove to be one of the best fields for this system." ‡

Armstrong and others see the greater possibilities in main line work, and this would seem to be the sounder position.

Inasmuch as superior merits for the crowded traffic conditions of large cities have been claimed for the single-phase commutator motor, it is of interest to compare the respective features of the continuous-current and the single-phase motor, since for crowded city work the former is at present exclusively employed.

For a given voltage the single-phase motor has the larger commutator, in order to take care of additional parasitic

* "High Speed Electric Railway Problems," Armstrong; American Institute Electrical Engineers, June 30th, 1903.

* With correctly designed modern motors, the necessary speed variation at constant load may be obtained by a rheostat in parallel with the field, and hence efficiently.

† *Electrical World and Engineer*, December 12th, 1903.

‡ In the same article (*Electrical World and Engineer*), December 26th, 1903, Mr. Lamme also states:—"Of course, it is recognised that for heavy railroad service, where all kinds of speeds should be obtained economically, the single-phase railway system will undoubtedly show to great advantage compared with any known continuous-current system. But, as considerable time will be required to equip any railroad service, it is probable that the single-phase railway system will be well tried out before there is a good opportunity to give it a thorough trial for heavy work."

losses.* The satisfactoriness of the design of the single-phase commutator motor is so dependent upon low voltage, that considerably less than 500 volts is advocated for some types, and is probably desirable for all. This leads to a further increase in size of commutator, and in the magnitude of the commutator losses. The more recent types of single-phase motors have an extra set of short-circuited brushes, thus two sets of brushes per pole, as against one set per pole for the continuous-current motor. The commutation will not be better than for the continuous-current motor.

The field spools of the alternating current motor have much the higher voltage per turn, and a breakdown in the insulation between one turn will occasion heavy induced currents in the short-circuited turn, promptly leading to the

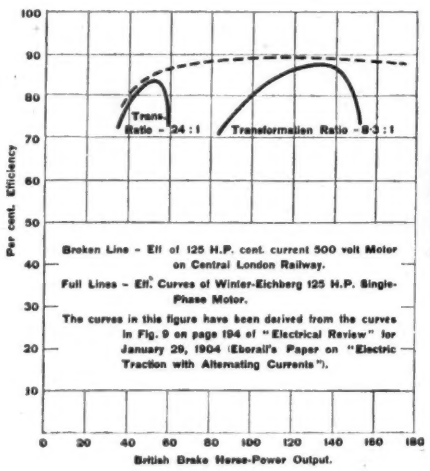

Per cent. Efficiency
Trans. Ratio = 24 : 1
Transformation Ratio = 8·3 : 1
Broken Line = Eff. of 125 H.P. cont. current 500 volt Motor on Central London Railway.
Full Lines = Eff. Curves of Winter-Eichberg 125 H.P. Single-Phase Motor.
The curves in this figure have been derived from the curves in Fig. 9 on page 194 of "Electrical Review" for January 29, 1904 (Eborall's Paper on "Electric Traction with Alternating Currents").
British Brake Horse-Power Output.

FIG. 1.

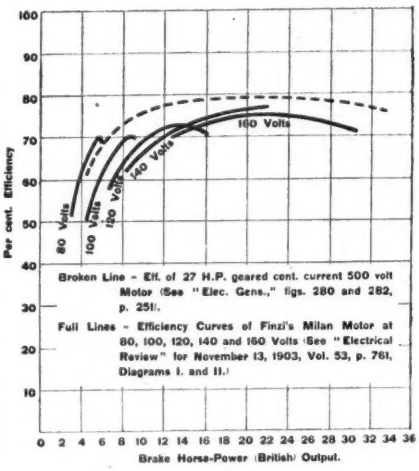

Per cent. Efficiency
80 Volts
100 Volts
120 Volts
140 Volts
160 Volts
Broken Line = Eff. of 27 H.P. geared cont. current 500 volt Motor (See "Elec. Gens.," figs. 280 and 282, p. 251).
Full Lines = Efficiency Curves of Finzi's Milan Motor at 80, 100, 120, 140 and 160 Volts (See "Electrical Review" for November 13, 1903, Vol. 53, p. 761, Diagrams I. and II.)
Brake Horse-Power (British) Output.

FIG. 2.

disablement of the motor for the time being. Such a breakdown does not result from the short-circuiting of a single field turn in a continuous-current motor.

The internal losses inherent to the single-phase motor are, according to rated capacity, periodicity, speed and voltage, at least from 15 per cent. to 35 per cent. greater than for the equivalent continuous-current designs.† Szasz (*Zeitschrift für Electrotechnik* for November 22nd, 1903, pp. 651—653), estimated that the losses in the single-phase commutator motor are much in excess of these figures. The motor must consequently be larger and heavier or run warmer for a given performance. The efficiency is consequently also considerably less. It has been pointed out by Szasz in the article above referred to, that in the compensated type of single-phase motor the efficiency falls off badly above and below certain very limited conditions of load for given ratios of transformation. This is also evident from figs. 1 and 2 of this article. Hence a good deal of intelligence would require to be exercised by the driver in operating on the most efficient controller notches for all conditions. Szasz points out that the efficiency curve of the continuous current series motor is far better sustained throughout a wide range of conditions.

The inferiority of the single-phase commutator motor as regards efficiency may be seen from figs. 1 and 2, relating respectively to the Winter-Eichberg* motor and the Finzi motor. The curves in fig. 1 are taken from Mr. Eborall's recent paper entitled "Electric Traction with Alternating Currents." The full line curves relate to the efficiency of the single-phase, and the dotted curve to the efficiency of an equivalent continuous current motor. In fig. 2 the full line curve represents the efficiency of the Finzi motor tested at Milan, and the dotted curve represents the efficiency of an equivalent continuous current motor. The data for Dr. Finzi's motor are derived from diagrams 1 and 2 of the ELECTRICAL REVIEW of November 13th, 1903, Vol. 53, p. 769. The continuous current motor used in this comparison is a standard 27-H.P. motor for which efficiency and output curves are given in figs. 280 and 282 on page 251 of "Electric Generators."

The power factor of the single-phase commutator motor falls considerably short of unity for all except a very narrow range of loads. In the case worked out by Mr. Lincoln the average power factor at the generators is 0·85. The power factor during acceleration is exceedingly low.

For the single-phase system considerable auxiliary apparatus is required on the car. This consists chiefly of step-down transformer and voltage regulator. Such apparatus is heavy and expensive and introduces further losses. The motors themselves are admittedly (Lincoln)† heavier and more expensive.

In the case worked out by Lincoln,† a car equipped with the single-phase system weighed 41·3 tons complete, as against 35 tons for the continuous current equipment. The total weight of electrical apparatus carried is thus in the single-phase system, well on towards double the weight in the continuous current system. This is confirmed by Lincoln's figures which show over 60 per cent. greater cost per (electrical) car equipment. Sixty per cent. greater cost in such apparatus is associated with a considerably higher percentage increase in weight.

The preparation of a rigid quantitative comparison is, in such a case as this, beset with difficulties, but it should be evident from the data set forth, that pending considerable further development, the continuous-current motor has, as yet, no rival in city and suburban work.

For inter-urban work it is believed that the 600-volt continuous-current motor can generally hold its own; nevertheless, there appears insufficient reason why advantage should not be taken of the higher economies incident to employing higher voltage at the motor.

Thus in Lincoln's comparison of a 60-mile inter-urban line, 600 volts is taken for the continuous-current system,

* These, and practically all the disadvantages of the single-phase motors, have been admitted by its advocates with commendable frankness.

† Lamme states the efficiency of the single-phase motors to be from 1 per cent. to 5 per cent. less than that of the continuous current motor (*Electrical World and Engineer*, December 26th, 1903, pp. 1043—1046). In this article Lamme gives the following useful summary of the component losses in the single-phase commutator motor:—

1. Iron loss due to reversals of magnetism in armature and field at the frequency of the supply circuit.
2. Armature iron loss due to variations in magnetism, dependent upon rotation of the armature.
3. Iron loss in the surface of the field and armature due to the punching of magnetic lines from the teeth of either element.
4. Losses in field windings.
5. Loss in armature windings.
6. Brush losses.
7. Friction and windage.

And on comparing each in turn, he shows that of these seven component losses, only one, the fourth, is as low as in the continuous current motor.

* The motor to which the tests refer was designed by Messrs. Winter & Eichberg. As is well known this type of motor, which has been developed by Latour in France and by Winter & Eichberg in Germany during the last few years, has brought the single-phase motor nearer to a distinctly commercial stage of practicability for traction and other purposes.

† "Interurban Electric Traction Systems—Alternating *v.* Direct Current," *Electrical World and Engineer*, December 12th, 1903, p. 951

and a cost for the secondary network amounting to 30 per cent. of the total cost of the electrical system is deduced. In fact, it is only by comparing a 3,000-volt secondary network for the single-phase system, with a 600-volt network for the continuous-current system, that an advantage appears to be obtained for the single-phase system.

The following criticisms of Mr. Lincoln's estimate appear sound :—

1. That he overlooks the fact that single-phase generators cost some 30 per cent. more than polyphase generators for the same rating and guarantees.

2. That he overlooks the increased cost of low periodicity transformers.

3. That there is no reason to employ many small and expensive single-phase transformers for the polyphase central and sub-stations. It is only in America that this has been customary, and now large polyphase transformers are being substituted for groups of single-phase transformers in America also.

4. That the single-phase generating plant is not sufficiently liberally proportioned, in view of the poor average power factor.

5. That since the chief handicap of the continuous-current system is, as Mr. Lincoln has pointed out, the low tension conducting system, the voltage should have been increased, as this is a perfectly sound proposition in the present state of the art ; much more sound than some of the features of the single-phase system he describes.

6. Large transformers are artificially cooled, and some attendance, such as very frequent patrolling, is advisable for the sub-stations, even with the single-phase system.

7. The high voltage per turn in the field spools of the alternating current system, the less satisfactory commutation, and the more complex auxiliary apparatus will inevitably result in a higher percentage depreciation than for the continuous current equipment. Nevertheless, Mr. Lincoln takes 10 per cent. for the former and 12 per cent. for the latter.

(To be concluded.)

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

Some Recent Improvements in Steel Conduits for Electric Wiring.

We have read with no little amusement the article on the above subject, which appeared in your issue of April 1st, 1904. To us, this article appears to be an advertisement of the special brand of "close-jointed" and brazed tube, with which we presume the writer is connected, and simply admits that the said tube is what it always was, and that after some six or seven years on the market, he is now prepared to furnish "an earthing device," with what result we must leave others to judge. He admits that there are on the market several brands of welded and solid drawn steel tubes screwed, but dismisses these with a few words, and simply ignores the great improvement this tube is on "close-jointed socketed tube," and says nothing of the great work done by those who have for many years pushed the adoption of good screwed tubes which could be satisfactorily earthed.

The writer begins by preaching the gospel of cheapness and cheap initial cost, and then goes on to review the "advantages" of close-jointed socketed tubes and screwed brazed tubes. He admits the socketed tubes cannot be efficiently earthed, and then goes on to say that where these tubes are not admissible screwed brazed tubes may be used.

Notwithstanding his admissions in respect to "close-jointed socketed tube," he later enumerates the kinds of work where it may be used, viz., mills, factories, works, public buildings, banks, &c., truly a formidable list ; but we venture to think that any consulting engineer would say that jobs of this class were worth a conduit system that could be efficiently earthed.

He then goes on to push the "Simplex" brand for all it is worth. One has heard before of the virtue of blowing one's own trumpet and the taking advantage of a free advertisement, but surely this is doing it with a vengeance.

We think that no one would begrudge him this ; but not content with blowing his own trumpet, he goes on to disparage competing improvements, and to throw out hints and misleading statements concerning the late Mr. Bathurst, and insinuates that he who firmly believed in, and did so much for, the introduction of the greatest of all improvements in conduit wiring, viz., steel tube with an insulating lining of *papier mache*, changed his mind, and turned his attention to an ordinary conduit system.

We will say nothing of the writer's want of good taste in bringing up Mr. Bathurst's name, but perhaps it would be well for us to state that Mr. Bathurst's connection with insulated conduits ceased, not because his opinion of that conduit changed, but on account of one of those regrettable differences which occasionally crop up in business, which, even if it were any use, this is neither the time nor place to discuss it, and as this company is the owner of the patents under which it is made, it could not be taken up by any one else, hence Mr. Bathurst's connection with ordinary conduit.

As the writer seems afraid to touch upon the advantages of an insulating conduit, perhaps we may be allowed to do so.

In the conduit made by this company, the insulation, which is waterproof and fireproof, prevents any sweating in the tube, and thus prevents any moisture getting to the cables. The insulating medium is inserted in such a manner that it forms a perfect contact with the interior of the tube, and prevents any creeping of moisture between the insulation and the tube. But perhaps the writer never heard of condensation ?

We could mention many cases of cables being pulled out after a few months, due to damp and rust from condensation in ordinary tubes, a combination which the best cable seems unable to resist.

The insulation prevents any leakage of currents into the tube, and in a properly-designed system such as ours, where all screwed joints butt together in the couplings, and where all elbows, tees, &c., are insulated, and having their internal diameter equal to the internal diameter of the tube, there are no shoulders or projections to abrade the cables in drawing in, and thus there is no damage of an earth.

All joint, ceiling, and fuse boxes are insulated, and one great advantage of this is that should a fire occur in the building, and the hose be brought into requisition to put it out, there is no danger of the water getting into the tubes.

It is specially recommended for theatres and public buildings, where the continuity of illumination often means the avoidance of a panic.

We surmise the article will have the opposite effect to that intended by the writer, and as for ourselves and the mechanical and electrical engineers and architects, we have confidence in their judgement and desire to use the best and safest system procurable, well knowing that, in the end, the best is cheapest.

A. E. Woodyer.

April 20th, 1904.

The Use of the word "Stewart."

Our attention has been called to an advertisement in your current number in regard to the name "Stewart," which we have reason to believe has misled many of your readers, and caused obstruction to our business. We should, therefore, be obliged if you would allow us to state explicitly the actual facts, on which we think that comment is superfluous.

The Stewart Electrical Syndicate, Ltd., sold certain arc lamps as "Stewart" arc lamps under an agency agreement, and to the best of our knowledge sold nothing else under the name "Stewart."

The agency of the company for these lamps was determined, and with it the company's right to apply to arc lamps the word "Stewart," which denotes solely those lamps for which their agency had ceased. The business of the Stewart arc lamps was acquired by us.

The only right which the Stewart Electrical Syndicate, Ltd., retained in the use of the word "Stewart," was to apply it to electrical goods other than arc lamps ; and in connection with such goods the name was unknown in the trade, and had no commercial value.

The Stewart Syndicate went into liquidation, and its manager obtained employment with another company, whose advertisement is in question. This company thereafter purchased what remained of the "goodwill" of the Stewart Syndicate business for £95, and began inserting advertisements to the effect that they had acquired the right which the Stewart Syndicate possessed to the use of the word "Stewart" in connection with the sale of electrical goods.

It will be seen from the above statement that the company has not acquired the right to sell its arc lamps as Stewart lamps, or to restrain the makers of the Stewart lamps from selling theirs under that name, and that Stewart arc lamps can be obtained only from ourselves, our agents, and our customers.

For **J. Defries & Sons, Ltd,**
W. Defries, *Managing Director.*

London, E.C., *April 20th*, 1904.

The German Atlantic Cable.

With reference to the article which appeared in your number of April 15th, the statement that the laying of the second section of the German Atlantic Cable would commence in April is incorrect. Our report only stated that the c.s. *Stephan* was expected to leave Nordenham on April 16th for New York, in order to commence from the American side.

We may now inform you that the ship left on the date in question.

Deutsch-Atlantische Telegraphengesellschaft.
O. Moll, *Managing Director.*

Köln a/Rh., *April 23rd*, 1904.

The Institution of Electrical Engineers.

I most heartily agree with "Electro-Vital" on the subject of persons getting into the above Institution. I was very much surprised to see in recent lists of new associates the names of two persons, who, to my mind, are very undesirable additions. I am not—like "Electro-Vital"—associated with the Institution myself, although I daresay I might become so, but while that body admit such "wasters," I am not at all anxious to enter.

The antecedents of both the above-mentioned are known to me. Neither have had any practical engineering training, and neither have been above falsifying their references to my direct knowledge, and I think it looks monstrous and grossly unfair on the part of those who propose such men that fuller inquiries should not be made, not only into their fitness from an engineering standpoint, but also their social standing. I, too, should be interested to hear the opinion of other readers. Hoping you will pardon me for drawing your attention to a subject which others, besides myself, are noticing.

Interested.

[We sincerely trust that our correspondent's strictures are less well-merited than he believes. The Institution has hitherto maintained a high standard of membership, which has, moreover, been raised from time to time, and any falling-off in the qualifications required of candidates would be deplorable. On the other hand, we may point out that the class of Associates is specifically designed to meet the case of persons who are *not* electrical engineers, but are closely associated with the electrical industries.—Eds. Elec. Rev.]

Municipal Appointments.

In last week's issue of your valuable paper there appears an advertisement which is of great importance at the present time when so much is said in favour of technical education. The engineer of the Burgh of Partick advertises for "assistant mains superintendent, previous experience with mains essential, B.P. lamps and meter testing." The salary for such a post commences at *20 shillings per week!!!!*

It would be extremely interesting to know the cost of a unit at these works, for *if* the rest of the staff are paid at the same rate, it should be very little.

Anti-Sweater.

NEW FUSE BOX AND FUSE.

The drawings which we give herewith show something new in the way of fuse boxes and enclosed fuses. Fig. 1 is a cross-section of a fuse box designed for two circuits, single pole; it will be seen that the terminals for these circuits are slipped on to their supporting insulators, the projections of the insulator tops holding the terminals in their places, and the insulator is similarly slipped into a socket cast on the box, thus doing away with all holding-down screws, and, the inventor claims, giving at least 10 times the insulation value obtainable with the usual types of pot bases, besides making the first cost of the boxes materially smaller. The boxes are designed to suit any class of cable, and any number of ways, all the insulators being interchangeable. The bus-bars for these boxes are similarly held in place, and it is intended to sweat the cables, in and out, into the solid terminal castings, and so to do away with the many contacts usually found in fuse boxes. The small terminal castings are prevented from slipping downwards by a projection of the metal lodging on the top surface of the insulator top. This method of fixing terminals has also been retained for joint boxes, tramway feeder boxes, and similar apparatus.

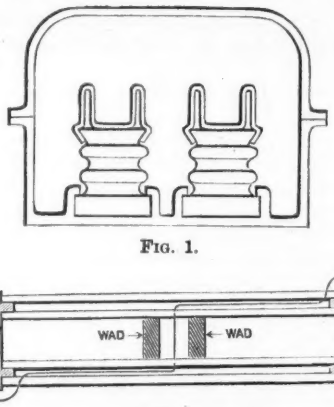


Fig. 1.

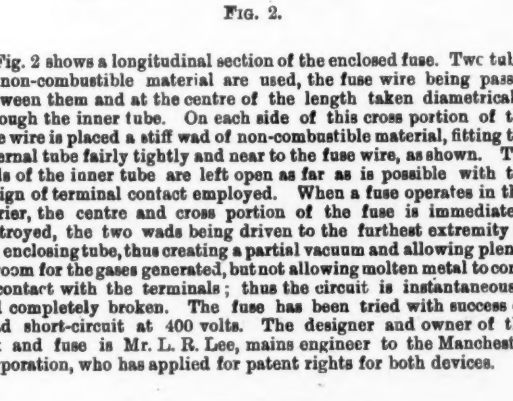


Fig. 2.

Fig. 2 shows a longitudinal section of the enclosed fuse. Two tubes of non-combustible material are used, the fuse wire being passed between them and at the centre of the length taken diametrically through the inner tube. On each side of this cross portion of the fuse wire is placed a stiff wad of non-combustible material, fitting the internal tube fairly tightly and near to the fuse wire, as shown. The ends of the inner tube are left open as far as is possible with the design of terminal contact employed. When a fuse operates in this carrier, the centre and cross portion of the fuse is immediately destroyed, the two wads being driven to the furthest extremity of the enclosing tube, thus creating a partial vacuum and allowing plenty of room for the gases generated, but not allowing molten metal to come in contact with the terminals; thus the circuit is instantaneously and completely broken. The fuse has been tried with success on dead short-circuit at 400 volts. The designer and owner of the box and fuse is Mr. L. R. Lee, mains engineer to the Manchester Corporation, who has applied for patent rights for both devices.

PARLIAMENTARY.

Royal Commission on London Traffic.

The Commission resumed its sittings on Thursday last week under the Presidency of Sir David Barbour.

Sir Robert Hunter, the solicitor to the Post Office, was the first witness called. He dealt at some length with the Postmaster-General's powers with reference to the construction and maintenance of telegraphs under the streets of London. Those powers, he said, were derived from the Telegraph Acts, or were the powers conferred by Parliament upon the old telegraph companies in 1863, subject to certain extensions and modifications in favour of the Post Office, sanctioned by subsequent legislation. The Postmaster-General did not claim to exercise any powers in the streets of London by virtue of Crown prerogative, but by virtue of the statutory authority possessed by him, although in some respects the fact of his being an officer of the Crown might affect any action taken against him by local authorities who alleged that their streets were unduly interfered with. Comparing the powers possessed by the Postmaster-General with those of the other principal undertakers who take up the streets, he said that, generally speaking, it might be taken that gas and water companies had the right to open and break up streets after a certain notice to the street authority, and subject to certain conditions as to control. Electric light undertakers were in the same position when particular works were once authorised. Before they obtained authority for a particular work, however, they had to give a general description and plan of it, and both the Postmaster-General and the local authority could make conditions. On the other hand, the Postmaster-General could not break up any street for the purpose of placing telegraphs under it, without obtaining the consent of the local authority, or in default of

that consent, the consent of the stipendiary magistrate or county court judge. The road authority could attach conditions to their consent, subject also to an appeal to the stipendiary magistrate or county court judge, if the Postmaster-General considered the conditions unreasonable. It had been held that those conditions must have relation to the use of the road and not to the mode in which the Postmaster-General was to use the telegraphs which he was laying. The proceeding which the Postmaster-General was compelled to adopt by the Telegraph Acts was much more cumbrous and tedious than that which was applicable to gas and water companies, inasmuch as great delay occurred in obtaining the consent of a local authority, and still further delay if that consent was refused. When leave had been obtained to place a telegraph under the street, it could be maintained without further consent. Where, however, the Postmaster-General had to break up a street, he must, except in cases of emergency, give 10 days' notice, and conduct the work subject to the supervision of the road authority. No more than one-third of a road could be closed to traffic at any one time. Although the Postmaster-General was bound to make good the road, it was invariably found that the road authority preferred to do the work themselves, under the power reserved to it by the Telegraph Acts, and therefore the time at which the execution of the work was undertaken was not under the control of the Postmaster-General. During the time that the main cables for the telephoning of London were being laid the streets had necessarily to be broken up and kept open for considerable periods, but the system had been constructed in such a manner that additional cable could be led in through manholes without any further breaking up of the streets. Speaking generally, the only reason now for breaking up a street was in the case of connecting new subscribers; and even those connections were not taken from the main cable in the roadway, but from service cables under the pavement, so that only a small portion of the pavement needed to be taken up. No difficulty had been experienced in arranging with the various road authorities, with the exception of the Westminster City Council, and an agreement was eventually come to with that body. He had noticed that one of the witnesses representing the City had expressed the opinion that all undertakers were subject to the provisions of the City Sewers Act of 1848, which provided that the opening up of a street should be carried out under the supervision of the Commissioner of Sewers, or, in other words, the Corporation of London. The Postmaster-General did not consider that he was subject to that provision. He (witness) was not aware that any attempt had ever been made to put in force the provisions of that Act against the Post Office. With regard to the proceedings between the City Commissioner of Police and the Postmaster-General, he said that they consisted of the issuing of summonses against two telegraph jointers of the Post Office for obstructing Aldersgate Street with trucks drawn up by the pavement. The case had come before a City Alderman, and had been dismissed on the ground that the trucks were not kept in the street any longer than was necessary. In the course of further evidence, witness said that the National Telephone Co. had no power to break up the streets of London apart from the authority of the Postmaster-General, which he could give under the Act of 1892. Such powers, however, were subject to the approval of the London County Council. Some few years ago the company executed certain works under streets with the consent of the road authorities alone, and an action taken by the Postmaster-General to enforce the provisions of the Act of 1892 was successful, and a perpetual injunction was granted against the company.

Mr. JOHN GAVEY, the engineer-in-chief to the Post Office, was the next witness. He said that he designed the telephone system of London. The work was done on a scale sufficient to provide for the wants of London for some time. Taking the City, Mayfair, Hampstead, Westminster, and Kensington districts, underground ducts had been constructed for nearly 60,000 subscribers. In the central district the cables were laid in earthenware ducts, which were laid in concrete in the principal thoroughfares, and in iron pipes in other streets. The average depth at which the ducts were laid was 2 ft. 6 in. from the surface to the top of concrete. The number of ducts ranged from 6 to 90, and each main duct was designed to contain one cable, which would hold from 217 to 306 pairs of wires, serving an equivalent number of subscribers. Branch pipes containing seven-pair cables were led out from the main ducts to the adjoining houses. Mr. Gavey corroborated Sir Robert Hunter's evidence as to there being little need for much breaking up of roads in the future in connection with the Post Office system, and said that the occasions on which a manhole had to be opened in the roadway were comparatively few. The operation of drawing in a main cable through a manhole, took about 5 hours, and the subsequent jointing from 10 to 20 hours. The average space occupied at the manholes was 12 ft. × 6 ft. at the end where the cable was introduced, and about 16 ft. × 8 ft. where the cable was drawn out. He submitted diagrams showing the nature of the operations. As far as possible the Post Office used the subways of the London County Council, but in Queen Victoria Street, and on part of the Thames Embankment, the subways, large though they were, were filled to so great an extent with gas and water mains that there was not room for the requisite number of telephone cables and ducts had to be laid in the roadway. A suggestion had been made that during construction the work in Queen Victoria Street might have been roofed in so as to carry traffic. That, said witness, was absolutely impossible. There were subways on each side of the street, connected by a diagonal subway, the roof of which approached to within 15 in. of the road surface. Below the subway was the Metropolitan District Railway, so that it was impossible to get under the subway, and the only course open to the Post Office, was, with the consent of the County Council, to replace the arched roof of the subway with a flat girder roof, which enlarged the space available for cables, to 2 ft. 6 in. In that shallow space 90 3½-in. pipes had to be placed, and it was obvious that a roof for traffic could not have been laid over work carried on so near the surface. Witness then dealt with the arrangements which existed between the Department and the Corporations of London and Westminster, and submitted figures which showed that the proportion of the Post Office openings and obstructions to those of local authorities was comparatively small. In regard to the suggestion that work should be carried on at night, witness said that such a thing was quite impracticable. There were many electrical difficulties. In the night it would be impossible to make tests to post offices (which would be closed) or to subscribers. There would also be considerable risk of damage to cables at night. He was not in favour of work being carried out simultaneously by authorities. In conclusion, he said that telephones tended to reduce the traffic in the streets, as an amount of general business was transacted over the telephone which would otherwise involve the employment of messengers and cabs.

On Friday, Mr. ALFRED WILLIS, formerly the general manager of the South-Eastern and Chatham Railway Co., and a director of the Baker Street and Waterloo Co., was called. In the course of his evidence, he said that he had come to the conclusion that it was too late in the day for Parliament or any other tribunal to lay down any general scheme for providing railway accommodation and traffic facilities within the metropolis. He considered that a great deal of the outcry against the congestion of street traffic was owing to the development of electric and telephonic enterprise. If to that were added the various street widenings going on, the construction of new streets and buildings, all of which involved heavy cartage through the streets, it would be seen that the metropolis had been undergoing a great deal of abnormal interference with the streets. In the future a good deal of the transit for goods and passengers on the surface would be conducted by motor traction, so that he looked forward, on the whole, to a diminution of the blocking of the streets. There was nothing in the suggestion that the new tubes being constructed would diminish the number of omnibuses in the streets. There would always be a demand for quick, short distance, "in and out," traffic which could not be met by tubes. He would not admit tramways to the City or the West End; on the whole, he was opinion that the requirements of the traffic within the City and West End proper were substantially met by the existing and projected tubes in conjunction with the omnibus services. It would be an improvement if the motor omnibuses were used. The best means of providing for suburban requirements was to encourage existing railway companies to supplement their services with tramway connections as feeders. Where the railway companies did not care to take the risk, other promoters should be encouraged, but not local authorities. Tramways might in some cases be of standard gauge so as to permit the trams running on the metals of local, main, or branch railways. Witness then went on to speak of the veto by County Council and local authorities. It had been a great stumbling block, and if a really good extra mural tramway service was ever really wanted would have to be swept away. It was not in the public interest. If tramway development were to be left to municipal enterprise, many promising schemes would be shelved. Speaking of workmen's trains, the witness said that he considered that the obligations imposed on railway companies had been very hard, and there had been a tendency on the initiative of the County Council and other local bodies to push the matter to an extreme. Coming to a consideration of existing Parliamentary procedure, he said that he had always been struck by three points:—the difficulty of amending plans after they had once been deposited; the costly risk promoters had to face; and the expense and waste of time on the settlement of minor clause matters in committee. Much of the time of a Committee was taken up by wrangles on small matters, which could well be adjusted by an inferior tribunal. He made the following suggestions:—All schemes relating to London and suburban traffic to be by way of Bill. Bills to be referred automatically by Standing Order to new tribunal. The new tribunal might be formed by an amalgamation of the lay members of the Railway and Canal Commission and the Light Railway Commission, with the addition of a traffic expert and a first-class engineer; or it might be set up as a new department of the Board of Trade. The former proposal would have this advantage, that there would be enough work to justify its existence, as it could carry on the work of the two Commissions. He suggested that preliminary plans should be deposited with the tribunal by May 1st in each year preceding the session of Parliament, together with a memorandum setting forth the main powers of the Bill. Copies of such plans and memorandum should be deposited with local and county authorities and with the Board of Trade for public inspection.

Mr. HERBERT T. SCOBLE, Professional Associate of the Surveyors' Institution, was the next witness. He dealt at some length with the subject of the transference of manufactories from congested town areas to suburban or rural districts. He considered that an artificial and uneconomical state of things had arisen in consequence of the efforts made hitherto to increase the facilities for traffic and to relieve the overcrowding in the housing of the working classes.

CHESHIRE ELECTRICITY AND POWER GAS.

ON Wednesday, 20th inst., Mr. HUMPHREYS, who was cross-examined by Mr. WEDDERBURN, said that by Clause 30 the promoters could purchase certain electrical undertakings in the proposed area. The estimates approximately balanced the capital powers sought by the Bill. If they carried out the purchase of other undertakings the expenditure on works would be reduced. Very little working capital would be needed, and no allowance had been made for it in the Bill. For the three gas stations which it

was proposed to construct first, they had allowed a working capital of £15,000 or £20,000. The maximum sum payable for interest during construction was £40,000. He admitted that no allowance had been made for contingencies at the small stations, and it was suggested that £25,000 should be set apart for that purpose.

Cross-examined by Mr. Honoratus Lloyd: The Bill would not create a monopoly in the supply of Mond gas in Cheshire, any more than any other Bills did.

Mr. Lloyd put it to Witness that there was a clause in the Bill providing for exclusive rights.

The Chairman said that the Committee would not be likely to pass the clause. He asked for information as to the position of the existing power gas companies.

Witness was then questioned on the point by Mr. Lloyd. In South Staffordshire there was one station completed with the machinery installed. The North-Western Co. had not done anything at present.

Witness was then cross-examined by Lord Robert Cecil and other counsel, and the Committee adjourned.

On 21st inst. Mr. James Fawcus, who was concerned in the promotion of the Yorkshire Power Co., and the Lancashire Power Co., and other power companies, was called to support the Bill. He considered that the area scheduled was one of the best in England for the purpose. There had been some difficulty in getting capital for such undertakings, but in the case of the Yorkshire and Lancashire schemes the inauguration of the works was close at hand. It would, no doubt, be impossible to get much of the first capital from the public, and the methods adopted in the Yorkshire scheme would have to be adopted here.

Cross-examined: While he spoke in favour of the scheme, he was not putting any money into it. He had other financial obligations.

Mr. S. Z de Ferranti was then called. He was prepared to give evidence on technical and financial matters, but the Chairman asked witness to confine himself as much as possible to finance. Witness corroborated Mr. Fawcus's statement as to the difficulty of getting the public to subscribe at first. Speaking of the Midland Electric Corporation for Power Distribution, he said that practically all the money was found by people interested in the electrical industry. Of some dozen schemes with which he was acquainted, only two had succeeded in getting money from outside.

Mr. E. M. Lacey, consulting engineer to the scheme, submitted estimates which, he said, were based upon 5,000-kw. stations. All the stations would not necessarily be of that size, however. The cost of a station of that size with gas-driven alternators he estimated at £179,000. £69,000 would cover the cost of 100 miles of mains for each station. The sub-stations would cost about £27,000 each. His estimates included land, and also 10 per cent. for contingencies. The total cost of the three stations to be erected at first, would be £538,000.

Cross-examined: His estimates differed from those he put in last year in the North-Western scheme. That scheme was the first of its kind however.

By the Chairman: He had never used Mond gas in connection with his other undertakings. It was only quite a short time ago that he had been satisfied that gas engines of a sufficiently large size could be made. He would be quite willing to "stake his reputation as an engineer" by advising a Corporation to put down a Mond gas plant in preference to steam.

Mr. E. A. Carolan, a director of the British Thomson-Houston Co., having given evidence, the Chairman ordered the room to be cleared, and on the re-admission of parties, the Chairman, without having heard the opposition, said that the Committee had come unanimously to the decision that the preamble of the Bill had not been proved.

London, Camberwell, and Dulwich Tramways.

On Tuesday, April 19th, Mr. T. S. Turnbull resumed his evidence. He and his friends would be prepared to find such amount of money as might be required. That, however, was on the assumption that the Committee passed the scheme so far as Peckham Rye station only. If the whole scheme were passed, they would find the whole of the money without limitation. They would be prepared to enter into a binding agreement to find the money on terms to be agreed upon with the company. The agreement should be submitted to the Committee before the Bill passed. Mr. Lloyd, K.C., objected to this.

Cross-examined: He was chairman of the company, and was appointed in the present year. He would retire from the chairmanship if there were an objection to an agreement while he held that position. He would enter into the agreement by himself alone.

Mr. R. Cousins considered that the passing of the Bill would mean a valuable addition to the local means of communication. Mr. W. C. Williams, Mr. J. Shelley, and Mr. G. Spurney also gave evidence.

On 20th inst., Mr. A. Ryde, a surveyor, was called, and spoke as to the cost of the land required for the generating station, &c.

Mr. Foxlee, consulting engineer to the scheme, was then recalled, and said that he thought it would be quite possible to run a single line to Rye Lane Station without infringing the statutory width of roadway required each side of the rails, with the exception of one 60-ft. length of line, where 3½ in. would be taken off each side of the roadway.

Mr. Lynden Macassay (for the promoters) said that, if it were found necessary, the promoters would be prepared to purchase forecourts.

Cross-examined by Mr. Courthope Monroe (for the Camberwel-Borough Council): The promoters would take out one of the crossovers in order to compensate for the narrowness of the roadway.

Mr. Foxlee and Mr. Sellon then discussed the question in private, and at the conclusion Mr. Foxlee said that it had been decided to leave out one of the crossings. The Peckham Rye crossing would be eliminated.

Mr. C. P. Grew, of a firm of contractors, gave evidence with regard to the state of the roadway.

On 21st inst. a number of local tradesmen from Rye Lane gave evidence in support of the Bill, and this closed the case for the promoters.

Colonel Yorke, chief inspector of railways for the Board of Trade, after having examined the plans, said that the width of the roadway in Rye Lane was such that he did not think the Board of Trade would be in a position to object to a single line of tramway. The Board of Trade had never made a practice of objecting to a single line of tramway if a space of 9½ ft. was available on either side. Sometimes the action of the Board of Trade had been in the direction of modifying a Parliamentary decision. Cases had arisen when the inspecting officer had not felt justified in sanctioning a line for traffic even when Parliament had authorised it. In one case it had been found that a car would have overhung the footway. He could not express an opinion as to whether 8 ft. was a sufficient width in Rye Lane. An electric tramway tended to increase the congestion of a crowded thoroughfare. The Board of Trade had recommended the practice of signalling for single lines, and he thought that it would be quite practicable in Rye Lane. He had seen the automatic system in America, and saw no reason why it should not be adopted in this country. Looking at the plans, he could not recommend a greater speed than eight miles an hour in Rye Lane, but experience might modify that. He had no personal knowledge of the traffic in the district.

Mr. C. W. Tagg, the Clerk to the Metropolitan Borough Council of Camberwell, was then called against the Bill. He went into the history of the line, and said that, for a period of four years, there was an intermittent service of one-horse cars. The service fell into disuse in 1901, and the lines were now very dangerous in places. The Board of Trade had refused to grant an application to take the lines up. He contended that, if the line along Rye Lane were sanctioned, then in five or six years' time, one side of the Lane would have to be rebuilt, and that would involve a large cost on the rates.

On the opening of proceedings on Monday, the Chairman of the Committee, Mr. Compton Reckett, said that the Committee had visited Rye Lane on the previous Friday evening and had carefully examined the thoroughfare. Evidence was given by Mr. J. W. Burchell, Parliamentary agent for the Bill. Mr. A. T. Moore, the Chairman of the Highways Committee of the Camberwell Borough Council, was called against the scheme. Other local opposition against the scheme having also been called, Mr. Lewis Coward, K.C., addressed the Committee on behalf of the Camberwell Borough Council, and Mr. Allan Baker, chairman of the Highways Committee of the L.C.C. also gave evidence.

On Tuesday Mr. Baker was further cross-examined. In the year 1901, when the Council were promoting their Bill, the Camberwell Council undertook to assist in procuring the removal of those portions of the lines which were in the way of the extension of the L.C.C. system eastward. The Bill was thrown out, however. The Committee held that Rye Lane was not suitable for a tramway unless it was widened.

Mr. Maurice Fitzmaurice, chief engineer to the L.C.C., did not consider the proposals in the Bill for the widening of Rye Lane were sufficient. Neither did he think that a five-minute service of cars would be possible. If the existing lines of the company were purchased, it might be found possible to use the line from Queen's Road in connection with the Council's constructed line to Lordship Lane.

Mr. Erskine Pollock, K.C., then addressed the Committee on behalf of the London County Council. The promoters of the Bill, he said, were asking for concessions such as had never been granted in the County of London to a tramway company. The company had never done anything for the public, and there had never been an efficient service. They had spent all their capital, and had not paid their rates to the local authority, and they had a judgement debt of £21,000. The company was not in a position to promote the Bill itself, and was relying on the Westminster Syndicate. It could not be said that the scheme would be carried out, as the syndicate might withdraw.

Mr. Honoratus Lloyd then replied on the whole case on behalf of the promoters.

The Committee having consulted in private, the Chairman announced that the preamble of the Bill had been found not proved. The Committee were unanimous.

Barnet Gas and Water Bill.—Electrolysis Clause Refused.

The promoters of the Barnet Gas and Water Bill, which came before Capt. Jessel's Committee of the House of Commons last week, sought to have inserted in the Bill a clause providing that the company should be in a position to claim compensation for damage from electrolytic action on their pipes and mains caused by leakage from any tramway, &c., to be laid in the future.

Mr. J. G. Newbigging, M.Inst.C.E., and engineer to the Gas Department of Manchester Corporation, was called to give evidence on the matter. He said that, in the past, there had been damage due to electrolytic action in Manchester. A committee of engineers was appointed by the Corporation in 1900 to inquire into the matter. Witness submitted samples of pipes, which had been damaged, for the Committee's inspection. One was a lead pipe which had been

under a tramway worked by electricity. The damage to it must have been caused by electrolysis, as an analysis of the ground in which the pipe was laid had shown nothing whatever which would act injuriously.

By the Chairman: The pipe had been in the ground for some three years.

Another pipe exhibited was an iron service main which had been in the ground for some 15 months.

In the course of further questions, Witness said that lead was affected twice as quickly as iron, which was due to the purity of the metal. Electrolytic action went on very slowly, and was generally not discovered until the damage resulted in a leakage of the main or pipe affected. The Manchester tramways were worked under the Board of Trade regulations. He considered that the protection sought was fair and reasonable.

Cross-examined by Mr. Harper: Manchester had not complained to the Board of Trade that their regulations did not give sufficient protection. The fact was that in Manchester the undertakings were all owned by the Corporation.

Mr. Harper asked if the pipe produced was the extent of the damage which had been done to the 2,000 miles of pipes and mains in Manchester. Witness said that it was not. The trams, however, ran over only 150 miles of the district. The tramlines crossed the pipe within 2 ft. of the bottom of the rail. The soil was ordinary loamy soil, and had nothing in it to hurt the pipe. Oldham was one case where such a clause as this had been granted.

Further cross-examined, witness said that he was not an electrical engineer, but he understood the subject of electrolysis. Damage depended on the quantity of the current, on the soil conditions, and on the length of time.

The Committee decided not to allow the clause.

Belfast and North-East Ireland Electricity and Power Gas Bill.—The Bill was fixed to come before a Select Committee of the House of Lords on Friday, under the chairmanship of the Earl of Lauderdale, but it was stated that all opposition had been withdrawn and accordingly the Bill was referred to the Select Committee on Unopposed Bills. The object of the Bill is to incorporate a company with a capital of £1,500,000, and to authorise the company to take lands and to erect generating or power stations in the parish of Ballymacarrett, in the City of Belfast, in the parish of Inver, the parish of Larne, the urban district of Ballymena, the parishes of Coleraine, Seagoe and Dinnelane. The area of supply is the counties of Antrim, Down, Armagh and Londonderry.

Bristol Corporation Bill.—After several days' hearing the Select Committee of the House of Lords, under the chairmanship of Earl Camperdown, has passed the Bristol Corporation Bill. The Bill extends the borough boundaries and transfers to the Corporation the powers conferred by the Barton Regis Electric Lighting Order.

LEGAL.

Maxwell *v.* B.T.H. Co.

In the King's Bench Division of the High Court on Saturday, Mr. Justice Kennedy heard the action of Maxwell *v.* the British Thomson-Houston Co., Ltd., and others.

Mr. Roskill, K.C., said the case came for further consideration in connection with third party procedure by the defendants, the British Thomson-Houston Co., against their sub-contractors, Robert W. Blackwell & Co., Ltd. The action was originally tried before his Lordship at the Leeds Assizes in 1901. The plaintiff, Mrs. Agnes Maxwell, of Halton, in June, 1899, was travelling on the outside of a horse tramcar along Cookridge Street, Leeds, while the tramways were being converted into electric tramways by the overhead trolley system. Some workmen, who were on a high platform fixing the apparatus on the posts, allowed an iron rod to project. This caught the plaintiff under the chin and severely injured her. At the trial there was a great contest as to who was liable, the Thomson-Houston Co. having contracted with the Corporation to install the tramways, and having engaged Messrs. Blackwell as sub-contractors, eventually the Thomson-Houston Co. were held liable to pay £850 damages and costs. They went to the Court of Appeal, which upheld the verdict. The Thomson-Houston Co., having brought in Messrs. Blackwell as third parties, now claimed that they, as sub-contractors, were liable to indemnify them.

Mr. Scott Fox, K.C., for Messrs. Blackwell, said the Corporation, having undertaken to make these tramways, had statutory power to interfere with the highway for the purpose of doing so, but they were bound to see that no injury was caused to the public. The Thomson-Houston Co., having contracted to do the work for the Corporation, sub-let it to his clients. His Lordship held, and the Court of Appeal upheld him, that, though the Corporation and their contractors had got his clients to do the work, it was their business to see that sufficient precautions were taken against injury to the public, and that they, having that obligation on them, had not fulfilled it. Now they said that under the contract with the sub-contractors his clients were liable to indemnify them for the damages and costs due to the lady. They had got to show a contract of indemnity.

After a long discussion as to whether the indemnity clause of the contract covered all risks, or was limited to accidents arising from construction and bad material, his Lordship gave judgement, holding Messrs. Blackwell responsible for the damages and costs awarded to the plaintiff, but not liable for the costs of the appeal. A stay of execution was granted.

Midland Electric Wire Co., Ltd., *v.* Electric Construction Co.

This case came on last week in the King's Bench Court before Mr. Justice Bigham. It was an action to recover the balance of account for goods delivered, and damages for loss of profit arising from non-acceptance of delivery.

From the reports in the Leicester papers, we gather that Mr. Lush, in opening the case, said the defendants were a firm of dynamo makers, who used insulated copper wire, which was covered with cotton. Plaintiffs took copper wire of the standard gauge ·075. If they specified that they wanted a thinner wire they had to pay more. The thinner the wire the more they paid, because it cost more to manufacture, and required more cotton to cover it. In January, 1903, plaintiffs quoted a certain standard price for copper, roughly speaking, 7d. a pound, and they also quoted the then current price for cotton. Plaintiffs made a contract in January, and sold to defendants 5 tons. A few months later, in April or May, a correspondence occurred, in which defendants desired to place further orders. Plaintiffs wrote back that both copper and cotton had risen in price, and in May, 1903, they gave a further quotation for copper, and a fresh quotation for cotton, based upon the then current prices. A contract was made between the parties in July for 10 tons, and defendants used the expression in their letter, "the prices are to be according to your quotation for cotton." That meant as well as the copper. The contract was made, and the bought and sold notes were exchanged. Defendants gave a specification of the thickness of wire they wanted. Plaintiffs having supplied a few tons, the defendants wrote back that a mistake had been made, and that plaintiffs had sent a higher-priced cotton than they had quoted for in January. Plaintiffs replied that no mistake had been made, that the quotation made was the latest for which defendants had asked, and that the contract had been made on those terms.

Mr. Powell, for the defendants, said his clients had never the May quotation in mind, and they had given the order only on the January quotation. He cited various cases in support of his contention that it was the duty of the Court to inquire into what was in the mind of the parties when the contract was made.

Mr. William Bullock, joint manager of the defendant company, said for 10 years he had never known the price of the cotton covering to go up, though he had known it to go down slightly. He had never known such a high price for cotton, and the plaintiffs could have purchased more cheaply elsewhere.

His Lordship held that the agreement was made on the May quotations, and plaintiffs could not be held responsible because defendants had forgotten the fact that they had received the quotation in May.

Judgement was entered for plaintiffs for £100, with costs.

Macartney, McElroy & Co, *v.* Brighton Corporation.

This case was before Mr. Justice Grantham and a special jury in the King's Bench Division on several days last week. It was a claim for £16,000 for work done in laying the first electric tramways in Brighton. The case was opened on 21st inst., continued on 22nd inst., and adjourned until Monday. A great deal of evidence was given.

THE CONTINENTAL ELECTRICAL ENGINEERING INDUSTRY.

The list of promotions in Germany during 1903 shows that three electrical companies were formed with a total capital of £305,000, as compared with 10 companies and £684,500 capital in 1902. These figures are instructive when contrasted with the companies established in 1897, which represented a share capital of £4,800,000, £2,300,000 in 1898, £1,700,000 in 1899, and £1,400,000 in 1900, while in the following year the total capital of new enterprises further declined to £322,500.

German Companies.

The Land and Marine Cable Works Co., of Cologne-Nippes, has succeeded in improving its position during 1903, the sales being the highest in the history of the works, notwithstanding the loss of certain large customers owing to the amalgamations of several companies. A year ago the net profits only reached £1,000, whereas for 1903 they amount to £16,405, which sum allows of the payment of a dividend at the rate of 5 per cent. as compared with nothing for 1902. The directors' report states that the efforts put forth for a short time with a view to the establishment of a price convention in order to improve the position of the cable industry proved to be abortive. It is expected that the company's cable works will also be well employed during the present year.

The Rheydt Electrotechnical Works (Max Schorch) Co., of Rheydt, which has a share capital of £62,500, has declared a dividend at the rate of 5 per cent. for 1903, as compared with 4 per cent. in the previous year, the net profits having amounted to £4,172. Complaints are made in the directors' report of the bitterness of competition, which at times compelled the company to refuse orders rather than work at a loss. In the second half of the year a large number of orders were booked at remunerative prices for machines and motors of powers ranging from 100 H.P. to 1,500 H.P.; and, as the demand and orders have continued in the present year, the directors have decided to lay down additional

machinery for the purpose of meeting the increase in business which is anticipated in the future.

The Hartmann & Braun Co., of Frankfort-on-the-Main, has improved its position during 1903. In the report of the directors it is stated that the turnover largely increased consequent upon the receipt of an abundance of orders, especially in the second half of the year. The sales of the more simple measuring instruments diminished, owing to the competition of inferior articles, but an augmentation took place in the orders for complicated apparatus. It is calculated that business with Russia and Japan will be prejudiced by the war, and in order to counteract any effects in this direction, a dividend compensation fund, amounting to £2,550, has been provided out of the past year's income. The accounts show net profits of £15,611, as compared with £9,456 in 1902, and it is proposed to pay a dividend at the rate of 8 per cent. on a share capital of £85,000, as against 7 per cent. in the preceding year.

The returns for 1903 of Ludwig Loewe & Co., of Berlin, show a further decline in the gross and net profits, although the dividend remains at the satisfactory rate of 10 per cent., which was paid for 1902, as compared with 12 per cent. in 1901, and 24 per cent. in each of the three preceding years. Thus more than the entire capital of £375,000 has already been returned to the shareholders by way of dividends, while, at the same time, the bonds in circulation have gradually been reduced from £500,000 to £400,000. The net profits for 1903 amounted to £40,190, as against £43,217 in 1902. The report states that the fusion of the A.E.G. and the Union Electricity Co., in the latter of which the company is interested, has already proved of economic advantage, but the war has affected the proposed reconstruction of the Russian Union Co.

The reorganisation of the South German Cable Works Co., of Mannheim, which was commenced in 1902, and necessitated a reduction in the share capital from £150,000 to £120,000, is now regarded as having been completed. According to the company's report for 1903, the orders on hand frequently caused overtime and night shifts to be worked, but the prices varied. On the one hand, the prices realised for a portion of the manufactures were satisfactory, while on the other, they often did not cover the cost of production. It is scarcely expected that an improvement in this direction will take place until a change occurs in the market and in competitive conditions. The accounts indicate net profits amounting to £11,511, as against £539 in 1902, when a dividend was out of the question. It is now proposed to pay 4 per cent. for 1903.

The Bergmann Electricity Works Co., of Berlin, whose share capital has gradually been increased to its present total of £425,000, continues its prosperous record, and the directors' report regards the results attained during 1903 as very satisfactory. In 1898 the company paid a dividend at the rate of 18 per cent. on the capital then entitled to participate in the distribution, in 1899 22 per cent., 1900 23 per cent., and in 1901 and 1902 17 per cent. each, while the distribution is maintained at 17 per cent. for the past year. The net profits amount to £89,920, as compared with £77,040 in 1902. The report points out that the favourable results are due to the considerable increase in the turnover, which was rendered possible by the bringing into full operation of the works' extension scheme. In addition to dynamos and electrical apparatus, the company makes a speciality of the manufacture of Bergmann insulating tubes.

The Car and Machine Works (Busch) Co., of Hamburg, which is interested in the English works of G. F. Milnes & Co., of Hadley, to the extent of over £33,000, has incurred a loss of £12,090 in 1903, as compared with a profit of £480 in the preceding year. The unfavourable results are attributed, among other causes, to the lack of orders, depression in prices, and the high expenses due to the increased endeavours put forth to secure contracts. It is not proposed to participate in the scheme of reorganisation of Milnes and Co., because it would at present be difficult to provide the necessary funds, and because the directors desire to concentrate their activity on manufacturing operations in their own works. Since this statement was made by the directors, the latter have informed a shareholder that the question of entirely writing off the interest in the English firm will be proposed at the next general meeting.

The accounts of the Duisburg Cable Works Co., of Duisburg, show net profits amounting to £8,791 for 1903, as compared with £3,747 in the previous year. After extinguishing the deficit brought forward from 1902, there remains a balance of £159 to be carried to the next account. The directors state that the prospects for the current year are more unfavourable than in 1903, and complaints are made of the extraordinary depression in the prices of all the company's manufactures.

The reorganisation of the Accumulator and Electricity Works (late Boese) Co., of Berlin, has not had the desired effect of restoring prosperity to the undertaking. In each of the years 1898, 1899, and 1900, the company declared dividends at the rate of 11 per cent., and in 1901 the distribution declined to 4 per cent., but for 1902 a loss of £15,814 was incurred, and the past year shows a further loss of £15,584 on a share capital of £225,000. The report of the directors attributes the unfavourable results to the fact that the financial difficulties of the company produced some uncertainty among customers, and it states that competitors utilised this circumstance to their advantage. At present, however, the company has on hand considerably more orders than at the corresponding period of 1903, but the general course of business cannot yet be regarded as thoroughly satisfactory.

Among other German works whose reports have not yet been issued, may be mentioned the Berlin-Hagen Accumulator Works Co., which proposes an increase in its dividend from 10 per cent. in 1902, to 12½ per cent. for 1903; the Electricity Supply Co., of Berlin, 8 per cent., as against 7½ per cent. in 1902; and the Insulated Wire Works (Vogel) Co., of Berlin, 6 per cent. as compared with 2 per cent. On the other hand, the Oberspree Accumulator Works Co., of Berlin, has incurred a loss of £4,246, thus increasing the deficit to £52,482

French and other Companies.

The accounts of the French Thomson-Houston Co., of Paris, show gross receipts amounting to £171,934 for 1903, as compared with £171,691 in the previous year, and net profits totalling £84,393, as against £82,571 in 1902. It is proposed to pay a dividend at the rate of £1 per share, or 5 per cent. on a capital of £1,600,000, being the same rate as in the preceding period. The report states that the earnings of the subsidiary companies in which the parent concern is interested are very satisfactory, especially in the case of the tramway undertakings at Nice and Bordeaux, and the electric supply company for the Mediterranean coast.

The Société Générale d'Enterprises Electriques, of Brussels, which is the Belgian representative of the Berlin Allgemeine, Union and Loewe group, is reported in Belgian circles to be in negotiation with the Société Electrique et Hydraulique (Dulait), of Charleroi, with a view either to the absorption of the latter or the establishment of a community of interests with it. This rumour is considered to possess more probability than the statements which have been circulated, alleging that the Allgemeine Co. intends to acquire possession of the Dulait works or make a working arrangement with that company.

The Alioth Electricity Co., of Basle, which has a share capital of £120,000, does not propose to pay any dividend for 1903, this negative result comparing with a distribution of 4 per cent. in 1902. The accounts indicate profits amounting to £13,109, as against £16,376 in the preceding year, but, with the exception of an insignificant sum carried forward, the whole of the former has been written off for ordinary and extraordinary depreciation of the works and tools.

The Felten & Guilleaume Cable Co., of Vienna, intends to pay a dividend of 10 per cent. for 1903, as compared with 12 per cent. in 1902; and the Electricity Co., late Kolben & Co., of Prague, proposes 4 per cent., as against nil. The Hungarian Siemens-Schuckert Works Co. is the title of the amalgamation of the Buda-Pesth branch of the Siemens & Halske Co. and the Hungarian Schuckert Co., of Pressburg.

The firms of Gadda & Co. and Brioschi, Finzi & Co., of Milan, which amalgamated a few years ago with a capital of £220,000, have now concluded an agreement with the Societá Elettrotechnica Italiana, of Turin, which has a share capital of £60,000. The agreement provides that the works shall be managed on common account, and the profits divided according to a definite arrangement which has been made. The object in view is apparently to form more intimate relations between the Italian works, in order the better to be able to meet foreign competition in electrical machinery.

BUSINESS NOTES.

The Elimination of the Dashpot in Arc Lamps.—It will probably be admitted by most engineers that a great percentage of the troubles inherent to arc lamps can be traced to faulty dashpots. Do away with this item in the lamp, and a great advance will have been made towards a perfect lamp, provided that there is no likelihood of other troubles being substituted. Of course, as is well known, lamps working on the hot wire principle require no dashpot, but hitherto solenoid-controlled lamps without dashpots have been commercially non-existent. After some years of experiment by Mr. Frank Proctor, of the Knewe Arc Lamp Co., 232, Hornsey Road, N., the following simple method has been found to give complete satisfaction. A core consisting of a few soft-iron wires, each a little longer than the length of the solenoid, is placed in the magnetic field of the solenoid, and rests on the bottom of the same. The controlling plunger, which is tubular, encloses this core. When the current is switched on, this loose core magnetically clings to the plunger, with the result that the arc is struck slowly, owing to the friction caused by the binding together of the two cores, and there is no preliminary pumping. After the normal length has been struck, it is maintained constant by the same magnetic binding in the following manner. Should the current increase, the arc is lengthened *slowly* owing to the aforesaid binding, and the pressing of this auxiliary core against the bottom of the solenoid; should the current decrease, the arc is shortened *quickly*, there then being no binding friction whatever, as the plunger simply takes up the auxiliary core. This core quickly slides to the bottom of the solenoid again owing to the downward pull. Should the lamp be extinguished from any cause, or be switched off in the usual way, the carbons come together at once, and in such a manner that it convinces one of the impossibility of the same "hanging up." It will be noticed that this arrangement acts not only as a dashpot in its damping effect, but also as a valve dashpot, inasmuch as a lengthening of the arc is effected slowly, and a shortening of the arc quickly. It might be thought that the auxiliary core would take away many of the magnetic lines of force from the controlling plunger, and thus render it less sensitive for working the lamp, but this is not so. We have seen one of these lamps at work, and certainly the arrangement above described appeared to control the movements of the mechanism admirably, the arc attaining its normal length at once when switched on, burning with perfect steadiness and feeding quite satisfactorily.

Exports of British Electrical Machinery.—So far this year there has been a falling-off in the exportation of British electrical machinery, the returns for the three months ending with March last showing a total of £95,303, as compared with £113,255 in the corresponding quarter of 1902.

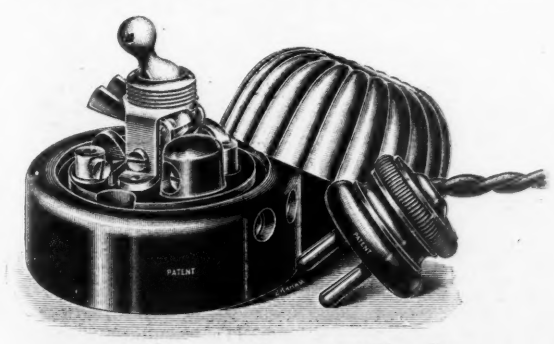
Electrical Wares Exported.

Week ending April 28th, 1903.		Week ending April 26th, 1904.	
Auckland	Value £99	Alexandria	Value £37
Azores. Teleg. mat.	3,081	Amsterdam	30
Bombay	263	Auckland	96
,, Teleg. mat.	150	,, Teleg. mat.	354
Bremen. Teleg. instruments ..	2,500	Bombay	240
Brisbane	80	Bremen. Teleg. mat.	50
Buenos Ayres	30	Brisbane	46
Calcutta	604	Brussels. Elec. fuses	250
Cape Town	80	Buenos Ayres	181
Demerara	42	,, Elec. machry. ..	2,057
Durban	1,519	,, Teleg. mat. ..	330
East London	924	Cairn	200
Fremantle	100	Calcutta	166
Hamburg	3	,, Teleg. mat.	210
Hobart	794	Cape Town	1,108
Honolulu	883	Carlskrona. Teleg. cable ..	210
,, Teleg. mat...	896,872	Colombo	25
Kure	572	Copenhagen. Teleg. cable ..	35
La Plata. Teleg. mat.	75	Durban	619
Larache	339	,, Teleg. mat.	65
Launceston	84	East London	169
Lisbon. Teleph. mat.	615	,, Elec. machinery..	1,097
Manila. Teleg. mat.	981	Fremantle	25
Melbourne	243	Gibraltar	79
Montreal	12	Hamburg	20
Napier	181	Hong Kong	351
Otago	3,600	,, Teleg. mat.	30
Penang	164	Kobe	268
Perth	61	Libau	22
Port Elizabeth	357	Madras	59
Port Said	35	Marmugoa. Teleg. cable ..	128
St. Petersburg. Teleg. wire ..	409	Malta	42
St. Michaels	20	Manila. Teleg. instruments ..	40
Shanghai	926	Melbourne. Elec. machinery..	305
Singapore. Teleg. mat. ..	254	,, Elec. mat.	40
Sydney	461	Nagasaki	579
Wellington	657	Otago	73
,, Teleg. mat. ..	357	Penang	591
Yokohama	177	Perth	183
		,, Elec. machinery	302
		Piræus	20
		Rotterdam	110
		Shanghai	193
		,, Teleg. mat.	40
		Singapore	28
		Sydney	517
		,, Teleg. mat.	220
		Tientsin	26
		Tokio	419
		Wellington	100
		,, Telephones	2,778
		Yokohama	1,343
Total ..	£918,576	Total ..	£16,496

Foreign Goods Transhipped.

Sydney. Elec. goods ..	Value £115	Calcutta. Elec. appts. ..	Value £122
		Fremantle Elec. cable ..	323
		Total	£445

Combined Tumbler Switch and Wall Plug.—We have received a sample pivot combination tumbler switch and wall plug from Mr. A. P. Lundberg, Pioneer Works, Islington, N. The switch is arranged for currents of 2½ amperes at 200 volts, and the plug socket is suitable for the maker's dot gauge 2-pin plug. The switch appears to be the maker's Standard "Pivot" tumbler switch in which the contact arm is locked in the "On" position, and modifications in the way of porcelain and fibre discs, cord grip plugs, &c., are equally applicable to both types of switch. Four substantial terminals are provided, each having large ($\frac{5}{32}$-in.) wire holes for looping-in; the two additional terminals allow the article to be adapted for a number of purposes, some of which are given below.

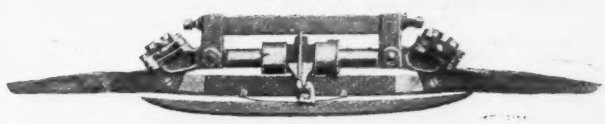


Combined Tumbler Switch and Wall Plug.

The connecting strap is so arranged that it can be easily removed to accomplish these adaptations:—(1) The switch movement can be arranged to control the plug circuit; (2) The plug circuit arranged independently of the switch movement, the latter controlling a different circuit; (3) The switch movement arranged to control the plug circuit and an additional one; (4) The switch and wall plug circuits can be connected to separate pairs of mains, should the necessity arise, and control separate lamps; (5) A motor-car cell connected in the plug circuit may be conveniently charged in series with a lamp; (6) A suspension pear switch connected with the plug part, and the circuit so arranged that both switches:—(*a*) Control the same circuit together, (*b*) Control the same circuit independently, (*c*) Control quite distinct circuits; (7) The contacts of the plug part can be specially arranged to supply current for Nernst lamps, and for similar cases where any change of polarity must be guarded against.

Self-Acting Section Insulator Bridge.—An improved section insulator bridge has recently been introduced by Mr. J. Money, of 18, Alma Place, Thornton Heath, Surrey. The device is shown in the accompanying illustrations, as adapted to straight under-running systems (fig. 1), side-trolley systems (fig. 2), and air-gap section

Fig. 1.



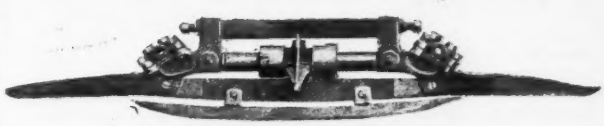


Fig. 2.

insulators (fig. 3). It will be seen that the bridging piece is slung from the wooden strip provided to guide the trolley wheel across the gap, by one or two screws passing through vertical slots. When the wheel runs on the bridging piece, the latter is pressed upwards so as to connect together the two sections of the trolley wire, and the supply of current to the car is, therefore, uninterrupted. In the case of the air-gap insulator, the bridging piece is slung from the metal on one side of the gap. It is impossible for the bridging

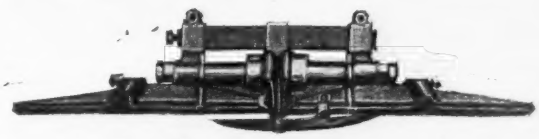


Fig. 3.

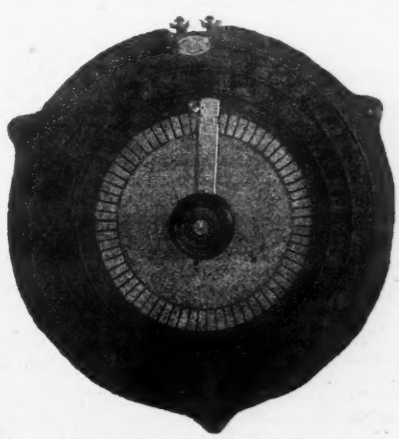
piece to short-circuit the gap except when pressed upwards by the trolley wheel, and when it is desired to put it out of action, as when one of the sections is undergoing repairs, it can be locked by an extremely simple device. The bridge is easily attached to any existing section insulator, and offers the minimum of obstruction to the trolley wheel.

Conduits for Poplar.—The Poplar Electric Lighting Committee has decided to adopt Messrs. Berry, Skinner & Co.'s patent concrete conduit system, under licence, in connection with the 60 miles of high-tension feeder extensions which are about to be laid.

Dissolutions and Liquidations.—A meeting of the Electrical Power Storage Co. is to be held on May 30th, at 4, Great Winchester Street, to hear an account of the winding up. This is not the present E.P.S. Co., but the one which was incorporated in 1882.

The Cleveland and Durham County Electric Power Co. is winding up, having transferred its undertaking to another company of the same name. Mr. G. D. Price, 5, Great George Street, is liquidator.

New Field Regulator.—The Sturtevant Engineering Co., Ltd., have recently placed upon the market a type of field regulator, illustrated below. It is the result of several years of study,

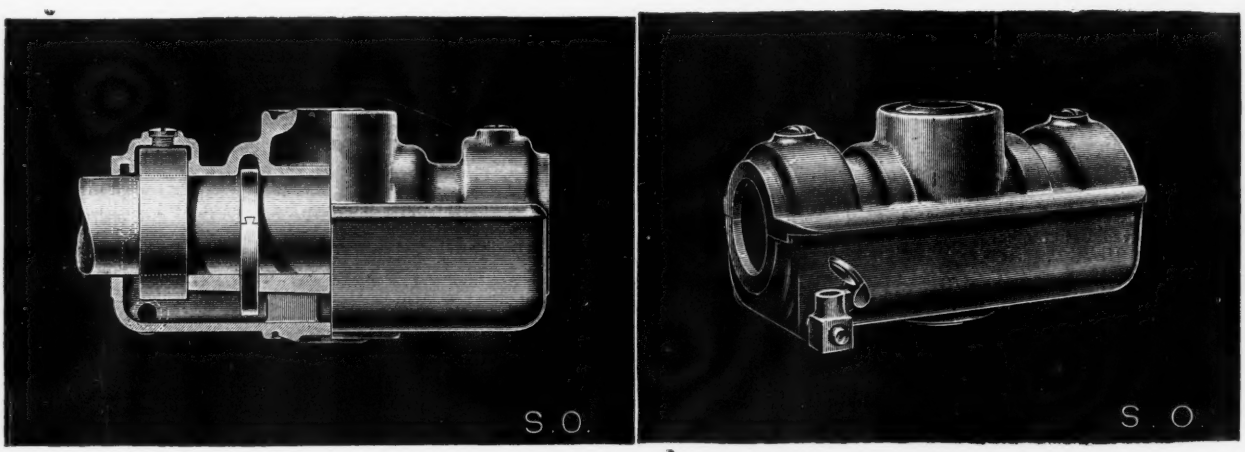


Sturtevant Field Regulator.

experiments and tests, and they claim that in its construction they have eliminated many objectionable features which have existed to a greater or less extent in several similar types of regulators. The apparatus consists of a base of insulating material to which are attached

the resistance, wire, contacts and lever; the whole is carried by a japanned iron casing, which not only gives the instrument a handsome finish, but prevents the possibility of direct contact with the heat radiating portion of the rheostat. No enamel or similar material is used in the construction, and the resistance material itself cannot disintegrate through misuse. Earthing is impossible on account of the insulating base, and the compound, by which the various current-carrying parts are attached thereto, is of such a nature as to become practically part of the base when the apparatus itself is complete. This substance possesses the qualities of insulation, heat conduction and radiation to a marked degree, and is so little affected by heat that the makers have frequently run the resistance wire to a white heat by passing excessive currents through it, without in any way causing the compound to deteriorate or separate itself from the base. This ensures the maximum factor of safety for the apparatus, as it makes certain that current will be carried without permanent damage up to the actual burning-out point of the wire itself. The working parts of the apparatus are all amply proportioned for their designed load. With field rheostats for mounting behind the switchboard a 5½-in. hand wheel is supplied, which is made throughout of copper, handsomely polished and lacquered, and is claimed to possess many advantages over the ordinary plated hand wheel. The wheels are of an entirely new design; their insulation is of a simple character, consisting of but a single large piece, and the loosening up of small parts is obviated.

Patent Self-Oiling Bearings.—The "Unbreakable" Pulley & Mill Gearing Co., Ltd., of West Gorton, Manchester, and 56, Cannon Street, London, E.C., have recently put upon the market an improved self-oiling bearing, of which we give two views. Self-oiling bearings are very largely in use on the Continent, and in this country they are being increasingly employed. It will be seen from the illustration that in the design of the bearing in question, the company have adhered to the swivelling principle on which all their ordinary bearings are constructed, and the new self-oiler is made to fit the same hangers and pedestals as the standard swivel bearing lubricated in the ordinary way. The advantages claimed for the bearing under notice are:—(*a*) Ample reservoir capacity. The 2-in. self-oiling bearing holds 1 pint of oil; the 3-in. 2½ pints, and the other sizes in proportion. This ensures great length of run and ample space for settlement of dirt; (*b*) No loose lids or covers; (*c*) The patent reversible elbow shown in the outside view serving for filling and level gauge when in position shown, and for emptying when reversed; (*d*) The outer casing of the bearing is made long enough to include loose collars when they are required, so that these share in the lubrication; (*e*) Ample oil lifting by two rings; (*f*) Everything in halves, including the rings, so that the bearing is easily put on the shaft. We understand that excellent results have been obtained with these bearings. In one instance 220 ft. of 2-in. shafting, driving by belt another line of 2-in. shafting 92 ft. long—a total length of 312 ft. altogether—carried in 35 of these bearings and loaded with pulleys with belts removed, was run at 260 revolutions per minute at an expenditure of 1¾ H.P.; the power being transmitted electrically, could be accurately measured. Were this 2-in. shafting doing its full work, it could transmit about 40 H.P. at the speed given, so that the percentage lost in bearing friction would only be 4½. Some 800 of these bearings have been supplied for the new Small Arms Factory at Ishapur, India.



Self-Oiling Bearings.

Book Notices.—"Dynamo, Motor and Switchboard Circuits for Electrical Engineers." By W. R. Bowker. London: Crosby Lockwood & Son. 6s. net.

"Radium und andere radioaktive Substanzen." By W. J. Hammer; translated by Ernst Rulmars. Berlin: F. & M. Harrwitz, *Der Mechaniker*. M. 2.50.

"Workshop Costs for Engineers and Manufacturers." By L. Pearn and F. Pearn. Manchester: The Technical Publishing Co., Ltd. 21s. net.

"Photography for all." By W. Jerome Harrison. Sixth edition. London: Iliffe & Sons, Ltd. 1s. net.

"La Pose des Lignes en Bronze, Cuivre et Aluminium." By E. Pierard. Brussels: Ramlot. 1 fr.

The Income-Tax Burden. By T. Hallett Fry, F.S.S. London: Horace Cox, Bream's Buildings. 6d. This is a readable contribution to a controversy which is very much to the fore just now, and it is of especial interest in view of the appointment of a Departmental Committee to inquire into the evasion of the Tax. It points out many anomalies which call for rectification if there is to be anything like equity in the imposition of this burden. Mr. Fry puts in a strong plea for reform, and in the course of his arguments raises some very pretty problems. Few subjects are so popular with the pampleteer as is the Income-tax, and perhaps these efforts will help to enlighten and coach up the public, so that sooner or later there will be a general demand for a great attempt being made to set wrong things right.

The Fire at the Iroquois Theatre, Chicago. London: British Fire Prevention Committee. Publication No. 81. This is one of the Committee's set of useful publications, and it possesses special and timely interest on account of the recent frequency of great conflagrations in Canada, the States, and, this week, in London. It consists of a descriptive paper by Mr. Edwin O. Sachs, the well-known authority on fire prevention matters, bringing out the technical facts relating to the Chicago Theatre calamity. A reprint appears of the new ordinances adopted by the City Council of Chicago immediately after the fire; a report of the coroner's inquiry; and constructional particulars of the building, compiled by the National Fire Protection Association, U.S.A. A number of photographs of the buildings after the fire, reprinted from *Insurance Engineering*, and sectional drawings of the structure, are given. It is by the publication of such matter as this that real good may result by the lessons of disasters being brought home to the men in whose hands the general public rests for its protection.

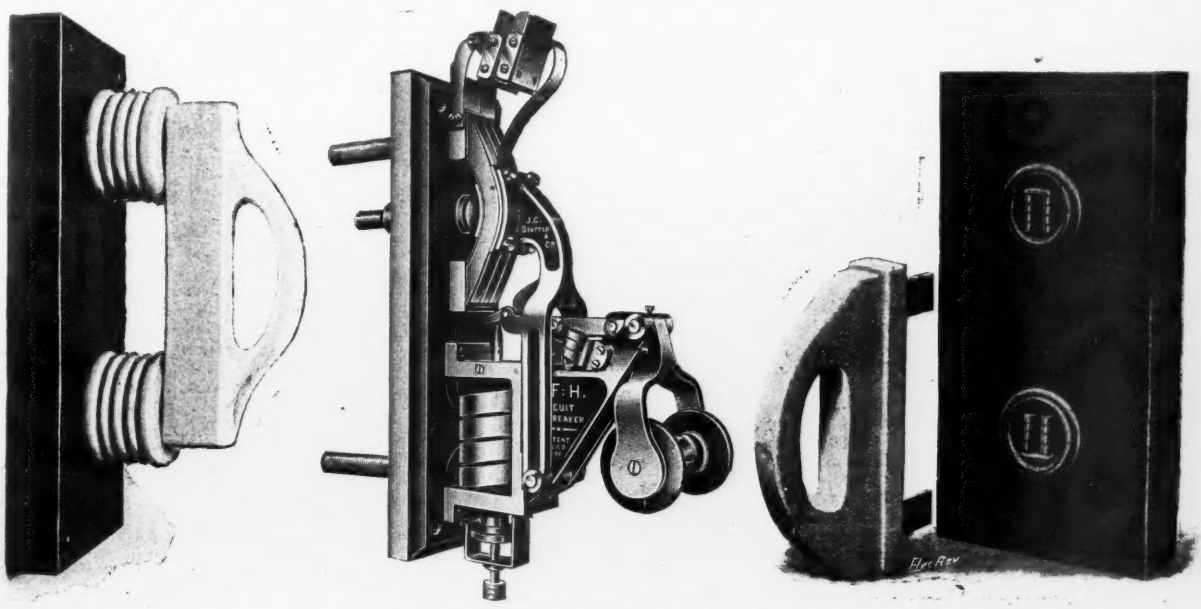
The Electrical Industry: Lighting, Traction, and Power. By Adam Gowans Whyte, B.Sc., Editor of *Electrical Investments*. London: Methuen & Co. 2s. 6d. net. This is not a work for the electrical engineer, though even he might find it useful for reference on occasions; it is about the electrical business, and has been written for business men by a man who has been associated with the business side of electricity. It covers the past of the industry in a general and interesting way, indicating the chief difficulties—mainly legislative—which have stood in the path of electric lighting, traction, and power. The book is one of the publishers' series of "Books on Business." Having said so much, we may best indicate the ground covered by citing the titles of the various chapters:—Birth of the Electrical Industry; Early Days of Electric Lighting; Electric Lighting in London; Electric Lighting in the Provinces; Early Days of Electric Traction; Development of Electric Inter-Urban Tramways; Electric Railways; Electric Power—An Industrial Revolution; The Economies of Electric Power; Electric Power Distribution Schemes; Electrical Engineering as a Career; The Future of the Electrical Industry.

The Statesman and the Bishop. By "John Draper." London: Arch. Constable & Co. 1s. net. Contributions to the fiscal problem have been as numerous as blackberries in autumn, during the past six months and more, and of those that we have seen this one is not by any means the least interesting. It is written in the form of a letter "to a gentleman in the diocese of Hereford," and discusses the attitude taken up by the Bishop of Hereford in his letter of December 26th, 1903, towards Mr. Chamberlain's Protection proposals. Into the intricacies of the problem, and the arguments advanced in refutation of the Bishop's contentions, we will not enter, but those who are studying the problem—and who has not been doing so of late?—may find the book worth spending an hour or two upon. There is a second section of it entitled "Tradesmen and Tariff" reform. As the pseudonym of the author will have indicated, the book smells of a drapery store, from cover to cover, and is an effort to influence that and other trades in favour of Protection.

How to Get Speed in Shorthand. By Frederick Pitman. London: G. Pitman. 6d. net. This is a shorthand exercise for stenographers who are anxious to develop speed. The entire pamphlet is written in shorthand, and in the course of 20 pages counsel is given to those who for commercial or hobby reasons wish to perfect them-

selves in the art. Notwithstanding all the opportunities which are placed at their disposal, the rising generation do not seem to devote themselves too zealously to acquiring proficiency in this direction. Thousands of lads take up the study, only to "turn it up" after a half-hearted attempt. For such this publication would be too far advanced, but those who have gone on so far as the easy reporting style cannot but obtain assistance from a careful plodding through this little educator. It might be of value to many assistants in commercial departments connected with electrical trade.

New Switchboard Accessories.—Messrs. J. G. Statter and Co., electrical engineers and contractors, of Birmingham, have introduced a new circuit-breaker, which has now been in use some time on the traction switchboard at Bury, and on the lighting switchboard at Batley; also for a shorter period of time on both lighting extension and traction switchboards at Colchester, on the lighting extension at Bath, on the tramway switchboard at Gloucester just completed, and on the lighting board at Radcliffe now being erected. From this it will be seen that the circuit-breaker is far beyond the experimental stage. Its principal advantages are that it has a free handle allowing the circuit to be open independently of any act on the part of the attendant, and, incidentally, the handle does not move when the circuit-breaker comes out. In order to re-engage the circuit-breaker, the attendant first raises the handle against no load, and brings it down against the load compressing the throw-off spring and the brush. The latter is firmly pressed down to the two contact plates shown by means of a toggle joint action. A further advantage is that it can be arranged to work either with or without a timing device, and although shown in the photo with a carbon brake, it is also made with a magnetic blow-out. Its construction is extremely substantial, and it is designed to take up very little space in width. Our other illustrations are of switchboard fuses, another speciality of the firm, one form showing a fuse with clips raised above the surface of the board, and protected by insulators, the other showing a type in which the contacts are sunk in the board, and surrounded by ornamental bushing. Both types have met with considerable appreciation on central station switchboards.



Statter's Circuit-Breaker and Fuses.

Catalogues and Lists.—A 16 pp. list describing the "Euston" H.P. steam trap has been sent to us by the Steam Fittings Co., Ltd., of Temple Bar House, Fleet Street, E.C. The traps, which are suitable for installations working at all pressures, from 80 lbs. to 300 lbs., have had a practical trial at St. Pancras for 18 months, working, it is said, perfectly under superheated steam. Some excellent half-tone pictures appear, and a list is given of 14 English electric lighting and traction stations where the Euston traps have been employed, and a number of electrical manufacturing, and engineering firms to whom they have been supplied.

A small list (14 pages) of specialities has been received from the Kirkstall Forge Co., near Leeds, detailing sizes of iron and steel bars, patent rolled shafting, bright compressed sections, and other special lines.

Messrs. W. H. Bailey & Co., Ltd., of Manchester, have in circulation a new pamphlet (No. 254) describing their improved system of air-lift pumping for raising water from deep wells. Full particulars, with drawings and photographic illustrations, are given of the "Koster" air compressor.

Messrs. Peto & Radford, Ltd., have issued a new list respecting their ignition accumulators and automobile accessories, also accumulator charging for motor-car depôts. The "Ashstead" accumulators are described and illustrated, also sparking plugs, testing instruments, electric lanterns, carriage lighting sets, induction coils, and various accessories. A loose list describes the "Energy" battery, which is a combination of a secondary and primary battery. There are two positive plates, and between them one negative plate. The negative plate consists of a lead envelope, formed by two lead sheets, joined together to form a pocket. The battery is charged as an accumulator, but the negative plate having no capacity renders the voltage of the battery nearly zero after an hour's discharge. The battery stands therefore at zero, and no loss in current takes place. When current is required, a pellet of cadmium is dropped into the negative pocket in each cell, 4 volts pressure is said to be obtained instantly, and the battery is ready for use. If the cadmium is removed, the battery ceases work.

The Westinghouse Companies' Publishing Department has issued a new pamphlet entitled "A Reconstructed and Enlarged Central Station," it being a description of the power plant of the Meriden Electric Light Co., of America, which was supplied by the Westinghouse Co., of America.

Football.—A football match between Veritys, Ltd., and General Electric Co., Ltd., of Glasgow, took place on Friday evening, the 22nd inst. The game resulted in a win for Veritys, Ltd., by 4 goals to 2. There was some brilliant play in the first half, notably that of Malcolm and Turvey on the G.E.C. side, and Barker, Brooks, Lamont and Wylie on the other side. There were quite a number of spectators from both firms.

With the object of augmenting the funds of the Newport Nursing Institute, the Newport and Cardiff electrical tramway employés met under Rugby rules at Newport on Saturday. The Cardiff men proved much the smarter lot, and eventually won by 3 goals 2 tries to 1 try. Mr. Collings Bishop, electrical engineer, of Newport, kicked off, and Mr. Arthur Ellis, Cardiff, restarted after the interval. The match was followed by a smoker, when votes of thanks were tendered to the respective engineers, and the health of both teams drunk.

Belgium.—La Société Franco-Belge pour les Applications de l'Electricité, of Brussels, reports a profit of £8,252 for the last financial year.

War Office Contract.—The Secretary of the Army Council has placed a contract with Messrs. Geipel & Lange, for 51 Geipel's steam traps, this being the third repeat order, for the Royal Gunpowder Factory, Waltham Abbey; this will make a total of 147 Geipel traps in use there.

American Electrical Machinery Exports.—Returns just issued show that the value of the electrical machinery exported from the United States during February last reached a total of £102,141, as compared with £83,207 in the corresponding month of 1903. The largest customer proved to be Japan, which took £23,971 of the total, as against only £1,438 in February a year ago.

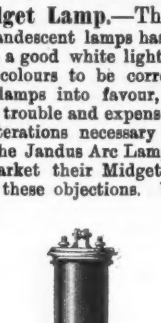
Annular Steam Trap.—In a recent circular the United Asbestos Co., Ltd., of Billiter Street, E.C., draw attention to their "Annular" patent steam trap. The device consists of a spring-loaded annular valve, brass expansion tube with internal tube, multiplying lever, and a cast-iron frame. Its action is stated to be periodic and positive, giving a full bore discharge; its sensitiveness is readily controlled, so that it operates at intervals from 1 to 10 minutes, with a fall of temperature of 5° F., and it will work at any pressure from 5 lbs. to 200 lbs.

Smoke Nuisance.—The Northampton Electric Power and Traction Co. were summoned at Wellingborough recently for causing black smoke nuisance. The Urban Council prosecuted, and Mr. Parker, who appeared on its behalf, pointed out that the dense smoke of which complaint was made, issued from a chimney which was really the property of the Urban Council, and erected in con-

nection with the refuse destruction works. During some part of the day, however, it was used by the defendant company, and black smoke was never emitted except when the chimney was being so used. The company was fined £3 and costs.

The Trafford Power and Light Supply Co. was on 21st inst. fined 10s. and costs in each of 10 cases for allowing the emission of black smoke from their generating station chimney.

The Jandus Midget Lamp.—The gradual increase of high candle-power incandescent lamps has created a demand for similar lamps, but with a good white light suitable for inside shop lighting, &c., allowing colours to be correctly appreciated. This has brought small arc lamps into favour, but their use has been restricted owing to the trouble and expense of re-carboning about every 10 hours, and alterations necessary to the wiring to run the lamps two in series. The Jandus Arc Lamp and Electric Co., Ltd., are placing on the market their Midget arc lamps, which are intended to overcome these objections. We understand that they



JANDUS MIDGET LAMP.

will burn for approximately 100 hours without attention, and can be run singly and efficiently on 200—250-volt circuits. The lamps are manufactured entirely at the Jandus Co.'s works, at Holloway, on the same lines as the larger patterns. Messrs. Drake & Gorham, Ltd., the sole agents for the Jandus Co., have issued a list giving full specification, a copy of which they will forward on receipt of business card.

Trade Announcements.—Messrs. J. C. Lyell & Co., 55, Victoria Street, S.W., have been appointed sole agents for Messrs. C. H. Andrews & Sons, Ltd., Stockport, for the sale of their electric motors, dynamos, and fans, for London and district.

Messrs. Julius Sax & Co., Ltd., have removed to 10 & 11, Great Newport Street, W.C., where large stocks are held, and all communications should be addressed.

Messrs. Heaney & Co., electrical engineers, have opened new business premises at 327, Borough Road, Birkenhead.

The Electrical Co., Ltd., is laying down additional test rooms, and a new workshop, at its address in Charing Cross Road, W.C., specially for electricity meters, owing to increased sales.

Mr. Ed. Brand notifies that he has removed his office from 63, Lancaster Avenue, to larger premises at 35, Shakespeare Street, Manchester.

LIGHTING AND POWER NOTES.

Bedlington.—Recently the U.D.C. received from the L.G.B. a letter stating that the prov. order granted to the electric lighting company would expire on August 2nd, and inquiring what steps were being taken in the matter. The Council decided to ascertain whether the company intended to provide the town with electric light.

Bridlington.—The first sod in connection with the local electric lighting scheme, was turned over on the 19th inst. by Councillor J. V. Mainprize, chairman of the Parliamentary Committee, at a spot near the junction of the Alexandra Sea Wall and Carr Lane, on the north side of the town. The Corporation proposes to take over the whole of the public street lighting. The cost of the installation will be about £20,000.

Brighouse.—Messrs. Lacey, Sillar & Leigh have been instructed to prepare specifications for the commencement of the E.L. scheme which the Corporation has in hand.

Carnarvon.—A L.G.B. inquiry into the application of the T.C. for a loan of £17,000 for E.L. purposes was held on April 21st. The Corporation has entered into a provisional agreement with the National Electric Construction Co. for carrying out the E.L. order, it being arranged that, if the loan is sanctioned, the company will pay £1,020 per annum for interest and sinking fund. If the undertaking is not a success, the Council will take it over at the end of 25 years without loss to the town, but if it is a success, the Council will have an opportunity of purchase at the end of 10, 15, or 20 years, and, during the first 10 years, any surplus over £1,530 a year will be paid to the Corporation. Objection was raised on behalf of a number of ratepayers.

Coventry.—At a T.C. meeting recently it was stated that last year the amount provided for the deficiency on the E.L. undertaking was £466, but that this year's working shows a small profit.

Devizes.—The T.C. has authorised its Electricity Committee to negotiate with any company which may desire to lease the powers under its electric lighting order.

Dundee.—The Tramway Committee of the T.C. on 25th inst. had under consideration a report by Mr. Richardson, the engineer, regarding the proposals to utilise the water at Lintrathen for the purpose of generating electrical energy. Three schemes were discussed, and it was pointed out that to generate energy on an adequate scale would involve an expenditure of not less than £120,000. The Committee resolved to postpone the consideration of the whole subject.

Gillingham (Dorset).—The E.L. scheme submitted to the Council by a company has fallen through, and the Council has decided to take no further action in the matter.

Glasgow.—The electric light was switched on in the Jordanhill district on the 20th inst.

The Electricity Department of the T.C. has repaid to the Gas Department the sum of £13,895, being the amount of the deficit on the operation of the electricity works for the year ending May 31st, 1903, which was transferred to the gas account in terms of the Glasgow Corporation Electric Lighting Order, 1890.

A sub-committee has been appointed to consider the present position of the arrangements, dates, &c., entered into between the Electricity and the Tramways Departments as to the supply of energy from the Pinkston power station to meet the coming winter's load of the Electricity Department.

The offer by Messrs. Willans & Robinson to purchase from the Electricity Department 10 steam engines and four dynamos formerly in the Waterloo Street and Kelvinside stations, which are now in disuse, for £2,750, has been accepted. The price is to be deducted from the amount of the contracts recently made with the firm to provide and erect steam turbines at Port Dundas and Pollokshaws Road stations.

The T.C. is to be represented at the conference of local authorities and companies owning electricity undertakings, which is being convened by the St. Pancras B.C. with the object of petitioning the B. of T. relating to actions against such undertakers for nuisance and damage.

Grays.—The electrical engineer, Mr. E. D. Long, in his annual report, states that there were 221 street lamps and nine motors connected with the system. The receipts during the year were as follows: Private consumers, £1,681; street lighting, £923; total, £2,604. The expenditure amounted to £1,518, which showed a gross profit of £1,086, but £1,159 was required for interest and loan repayments, leaving a deficit of £73. The T.C. has decided to revise the charges for lighting, as follows: Consumers to have the option of 7d. and 3d. instead of 7d. and 4d. per unit maximum demand, or 5d. per unit flat rate.

Greenock.—The expenses to the Corporation of the recent arbitration on the subject of the price of electricity to the tramways company, the rent for cable-ways, &c., amount to £753. It has been agreed to purchase the free wiring installations of the National Electric Wiring Co. for £382.

Ham.—The U.D.C. has received from the B. of T. an intimation that a prov. order has been granted to the Twickenham and Teddington Electric Supply Co., Ltd., giving powers to supply energy in its district.

Holyhead.—Mr. Price White, who has prepared a free estimate for lighting the whole town by electricity, has been instructed by the U.D.C. to draw out plans and specifications at a fee of 35 guineas.

Hornsey.—The U.D.C. has resolved to alter the price of energy for power purposes from 2d. per unit to 2d. for the first 80 units; 1¾d. for the next 80; 1½d. for the next 140; and 1¼d. for all above 140 units.

Kettering.—The U.D.C. has adopted the following scale of hire charges to consumers:—12½ per cent. per annum on the cost of installations and for motors and fittings, including the necessary wiring, under hire-purchase agreement for ten years; for hiring alone, a rental of 6 per cent. per annum on the actual cost for installations, and 8 per cent. for motors, &c. Consumers are required to enter into agreements for the hiring of wiring, &c., and of motors for not less than three years.

Kingston-on-Thames.—The Board of Guardians has applied to the L.G.B. for a loan of £2,250 for the installation of the E.L. in the infirmary.

A L.G.B. inquiry was held on April 19th into the application of the T.C. for a loan of £15,850 for E.L. purposes. Of this sum £2,259 represented excess expenditure, £3,110 for generating plant, £3,800 for mains, £1,000 for disconnecting pillars, £1,700 for transformers, £3,360 for services, and the balance for miscellaneous items. There was no opposition.

Launceston.—The B. of T. has refused to allow the T.C. to receive as rent £25 a year from Messrs. Crompton & Co. for the transfer of the Council's rights to them under the prov. order. The T.C. has resolved to take counsel's opinion on the matter.

London.—BATTERSEA.—Mains extensions estimated to cost £273 have been passed by the Lighting Committee of the B.C.

POPLAR.—Cable extensions estimated to cost £2,367 are to be carried out by the B.C.

BETHNAL GREEN.—The E.L. Committee of the B.C. has decided to proceed with the scheme for the electric lighting of the borough. The estimated cost of the scheme is about £100,000.

London.—Marylebone.—On Wednesday last the report of the delegates of the B.C. on their negotiations with the Metropolitan Electric Supply Co., Ltd., was issued. Under date the 19th inst. the company made the following alternative offers:—

1. Supply of energy in bulk.—In consideration of the Council taking from the company the whole of the energy required in the borough, the company are prepared to accept the price of ¾d. per unit for the quantity supplied in excess of that represented by two hours' average daily supply during each quarter of the maximum demand made upon the company in the quarter, the said two hours' average daily supply being charged at 3d. per unit; the average price of the whole of the current supplied in any one year not to exceed 1·70d. per unit. This scale of charges will probably, under existing conditions, work out to a lower rate than 1·70d. per unit, and if the Council considerably increases its motor and street lighting loads, and provides storage batteries sufficient to take a reasonable proportion of the peak, the average charge should not be more than about 1·40d. The supply to be given for a period of 27 years from January 1st, 1905, with the right to either party of claiming a revision of price at the end of 9 and 18 years, the revised price to be settled, failing agreement, by arbitration in the manner provided in the agreement of May 8th, 1901. As part of this arrangement, the company will be prepared, if required, to provide and fit up in any sub-station to be erected by the Council in St. John's Wood or in the existing generating stations at Manchester Square or Rathbone Place (if the Council remove the steam plant and adapt those stations for transforming purposes), such motor-generators as the Council may require, together with all necessary switchgear, balancers, starting machines, cable connections and travellers, for the sum of £7 10s. per kw. In this way, the contemplated outlay by the Council of from £280,000 to £300,000 on a 9,000-kw. generating station, with the necessary machinery and trunk mains, would be reduced to £41,000 for all the additions necessary to bring up the capacity of the existing transforming plant in the borough to 9,000 kw., subject only to the cost of altering the present buildings. No estimate of that cost has been made, but it cannot be much, especially after giving credit for the value of the existing steam plant. If desired, the company will have plans prepared, and name an inclusive sum for which they will undertake to alter as well as equip these two stations, in which sum will also be included, if the Council wish it, the cost of erecting a sub-station in St. John's Wood, on a site to be provided by the Council. 2. Lease of the Marylebone Undertaking.—As an alternative to the offer of a bulk supply, the company is prepared to accept a lease for the same period of 27 years, on terms which will relieve the Council of all charges for interest and sinking fund (except in respect of costs) which will devolve upon them during the currency of the lease under the pending Bill as amended in Committee of the House of Commons, subject to the company having power at any time to terminate the lease on two years' notice in the event of another order being granted and confirmed by Parliament. These charges are stated to be:—(1) Interest, at a rate to be agreed, on £1,212,000 payable under the award, and on capital expenditure in 1902, 1903, and 1904, estimated at £150,000. (2) Sinking fund on a 3 per cent. basis in respect of the above-mentioned sums repayable in 35 years from January 1st, 1908. The directors are strongly of opinion that the costs of the arbitration should not be capitalised and that each party should bear its own costs. They are, therefore, prepared to return to the Council the amount which has been paid to them under taxation. The company would also provide all the capital required for the business in Marylebone during the lease, subject to repayment on its termination, less 1½ per cent. per annum from the several dates of expenditure. As bearing upon the question of depreciation, it must be borne in mind that the plant which depreciates most—the steam generating plant—is outside the area and will be maintained at the sole expense of the company.

After considering reports upon these offers by Mr. Wright and Messrs. Price, Waterhouse & Co., the delegates unanimously recommend the Council:—(1) Not to accept the company's proposals; and (2) To instruct the Electric Supply Committee to proceed with as little delay as possible to have the necessary plans and specification prepared so that the sum of £400,000, exclusive of the cost of the site, be expended for the purpose of erecting a generating station and purchasing the necessary plant and machinery and for the finishing of the conversion to a continuous current supply of the districts not yet completed by the Metropolitan Electric Supply Co.

The Works Committee has agreed to hand over a site, being a portion of one of its depôts, to the E.L. Supply Committee for the purpose of erecting a generating station.

Wandsworth.—With reference to the appeal by the County of London Electric Supply Co. against one of the conditions (viz., that the whole width of the tar-paved footpaths should be re-topped), subject to which the B.C. approved the laying of certain conduits, the B. of T. has allowed the appeal and approved the works, but without prejudice to the terms of any special agreement which may have been made between the Council and the company with regard to the reinstatement of streets.

Manchester.—The following is the report of the Electricity Committee of the Corporation for the year just closed:—The total expenditure amounts to £261,850. Dividing this into running charges and fixed charges, it will be found that the former show marked economies and the latter heavy increases. Running charges amount to £53,196 for an output of 28,953,459 units, as compared with the previous year's total of £48,489 for 17,400,223 units, or ·44d., as against ·67d. per unit. This saving is mainly due to a reduced consumption of coal, oil, waste, water, &c., and to the plant requiring less for maintenance. Fixed charges amount to £208,654, which, divided by the aggregate of consumers' maximum demands (measured at the generating stations), equals £12 1s. per kw. For the previous year the corresponding total was £140,365, equalling £10 19s. per kw. The additions here are principally as follows:—Distribution wages from £7,525 to £12,448; rents, rates, and taxes from £12,172 to £15,419; interest and sinking fund payments from £76,538 to £107,727; the provision of £25,000 for future renewals. During the earlier years of the department a renewals suspense fund was built up to the extent of £17,578, but was exhausted by March, 1900. In the case of management expenses, which also come under the heading of fixed charges, these show a substantial reduction—from £14,615 to £11,766. The income during the past year from lighting and traction sales is as follows:—

	Lighting at 5½d. per unit.	Lighting at 1½d. per unit plus fixed charge.	Traction.
During 1903-4 ...	£70,484	£75,973	£100,000
During 1902-3 ...	61,937	63,885	52,463
Increase ...	£8,547	£12,088	£47,537
Increase per cent.	14	19	90

From power sales the income is £13,830, being £1,766 less than last year, notwithstanding the increase of 766,511 units in the quantity sold. This is explained by the reduction in price.

Pollokshaws.—The Corporation Electricity Committee has recommended that if the E.L. order now being applied for by the Clyde Valley Electric Power Co. is refused, and T.C. obtain an order for themselves, the Glasgow Corporation should supply the energy.

Rochdale.—For the first time the Corporation electrical undertaking shows a profit, the surplus being £622. Last year there was a deficit of £1,492, and in the previous year of £2,385.

In order to meet the demand for energy for the tramways, additional plant is to be provided at an estimated cost of £15,000.

Skipton.—Messrs. Baker, Lees & Co. have asked the Council if it is willing to allow its powers under its prov. order for electric lighting to be taken over, upon terms, by a company.

Stratford-on-Avon.—The T.C. has resolved to ask the Southern District Electricity Corporation to arrange an interview with its E.L. Committee with a view to fully discuss the question of lighting the town by electricity. Messrs. Baker, Lees & Co. have reminded the T.C. that the B. of T. on December 17th last wrote respecting its prov. order.

Thames Ditton.—The U.D.C. has come to an agreement with Edmundson's Electricity Corporation with respect to the prov. order being applied for, the company having decided to erect a power station in the district, if necessary, and agreeing to the charges for energy proposed by the Council.

Warrington.—A L.G.B. inquiry was held on 26th inst. into the application of the Corporation for sanction to borrow £5,000 for electric lighting purposes. It was pointed out that the expenditure was in connection with the extension of mains in the borough, for increasing the area of supply of electricity, and sundry additions to plant and buildings.

Whitchurch.—The South Wales Electrical Power Co. has been granted permission to lay cables to the Melingriffith Works, Whitchurch, and the Phœnix Brickworks. The Whitchurch P.C. has resolved to write to the district council to inquire what steps, if any, would be taken to light the town by electricity.

Windsor.—The Electrical Installation Co., Ltd., has offered consumers the option of a flat rate of 6d. per B. of T. unit, with various discounts, or a maximum demand rate of 12s. per 8-c.p. lamp per annum, and 3d. per unit for all excess units.

Worcester.—The T.C. has decided to erect an iron and glass switchboard gallery, and steps, at the Powick station, at a cost of £90, in order, it is stated, to avoid danger from fire such as recently occurred at Bristol. The Nevile Engineering Co. has been entrusted with the work.

The Council has also resolved to approach Electromotors, Ltd., to endeavour to get a hiring agreement signed in reference to the company supplying motors on the two years' hire-purchase system, and at the company's own risk and cost, collect the instalments of the purchase money, less 5 per cent. This was proposed by the electrical engineer, who advised the giving up of the hire of motors.

TRAMWAY AND RAILWAY NOTES.

Blackpool.—The result of the past year's working of the Corporation tramways shows a slight falling off. The estimated receipts were £42,126, but the actual revenue fell short of this by £113. The car receipts alone were £427 below the estimate. A year ago the profit, before taking interest and sinking fund into account, stood at £15,995; this year the figure has dropped to £14,698. For the former year the interest and sinking fund amounted to £11,678; this year it has risen to £13,666. After deduction of this and other charges, there remains a net profit of £56.

Brighton.—The T.C. has instructed the engineer to commence laying the tramways in North Road and Queen's Road as soon as the Dyke Road tramway is practically completed. The engineer stated that he hoped to have this line ready for use in July if started soon; there is no doubt that it will be considerably patronised, taking people from the railway station to the sea front, and *vice versâ*. The construction of the tramways in Dyke Road is proceeding quickly, and the line should shortly be ready for inspection.

Chatham.—The Chatham and District Electric Tramways Co. have written to the Gillingham T.C. that they propose to adopt a universal penny fare for all distances in regard to all children. The company do not see their way to applying this fare to adults.

Chester.—The T.C. has decided to extend the electric tramway in the City to Boughton, at an estimated cost of £16,000.

Folkestone.—The T.C. has received the report of Mr. C. H. Merz, respecting the proposed electric tramways. He strongly recommends the overhead system, provided the objections of Lord Radnor, the Lord of the Manor, to overhead wires, can be overcome. The slot conduit system is quite out of the question on the ground that it would be a commercial failure, but the "G. B." surface contact system is worthy of a trial. The capital cost of the

"G. B." system would be £7,200 per mile of single track, against £6,400 for overhead equipment. He also recommends the Council to obtain energy from the local electric light company, instead of generating it. The Council has decided to approach Lord Radnor with the object of securing his consent to the overhead system.

Glasgow.—The T.C. has disapproved of the introduction of a red spot or band on electric and gas lamps at the tramway stopping places, so that these might be as clearly observed as possible after dark by intending passengers. The experiment has not been a success.

Leicester.—At a meeting of the Council on Tuesday, it was stated that it was hoped to formally inaugurate the service of electric trams for the borough on May 18th. It is exactly 12 months since the work of laying down the new service began, and the expedition with which it has been carried out has given general satisfaction. Trial trips with the new cars have proved most successful.

L. & N.W. Railway.—It is reported in a daily paper that the Newport Pagnell branch of this railway is shortly to be converted from steam to electric traction on the same system as the Liverpool and Southport line.

Mansfield.—Messrs. Bramwell & Harris have informed the T.C. that the tramway company intends to carry out the Mansfield and District Light Railways Order in its entirety, and not to drop any part of it.

Scarborough.—On 21st inst. a trial run was made over the electric tramways.

West Bromwich.—Unless conciliatory counsels prevail there is a grave danger of litigation between the Corporation and the South Staffordshire (Lessee) Co. The Corporation purchased the tramways at the expiration of the old lease, but agreed to reconstruct the lines for overhead electric traction, and to again lease them to the company. An agreement to this effect was entered into, and signed by both parties. As soon as the reconstruction was completed, and the tramways were passed by the Board of Trade, the company commenced to work them; but as they then discovered that the permanent way was not properly laid, they refused to sign the lease until the permanent way was put right by the Corporation. The company, on their part, assert that they informed the Corporation that the lines were not being properly laid at the time, and, consequently, they refuse to pay the annual rental agreed upon until the lines are put right. They have, however, already paid over to the Corporation the same amount as was formerly paid to the old South Staffordshire Co. This was stated to be considerably less than would have had to be paid if the new lease had been signed. The Corporation has demanded payment of the full amount, as it has been advised that the agreement is as binding as the lease itself. The company, on the other hand, refuse to pay until the lease is signed, and they decline to sign until the permanent way is put right. The Corporation has now mentioned a specific time for the company to pay over the money, and unless an amicable settlement is arrived at in the meantime, it is feared that legal proceedings will follow.

West Ham.—On Tuesday the Corporation adjourned the consideration of a scheme for giving bonuses to motormen and conductors. The suggestion is to present £1 per month to the most deserving man in each of the two classes. In making the award to motormen regard would be had to immunity from accidents, careful handling of cars, &c., and in the award to conductors to receipts of cars, freedom from complaint, neatness of cars, &c.

Wolverhampton.—The Willenhall Road section of the tramway system has now been completed. Cars have been run on the line as far as Coventry Street since Easter, and on Friday in last week the length from Coventry Street to Dean's Road was opened for traffic. By the opening of this length, communication is established to Willenhall, but passengers from Wolverhampton have to change at Dean's Road from the cars run on the surface contact system to those run on the overhead system by the B.E.T. Co. With respect to the Wednesfield Road tramway, now in course of construction, there is trouble ahead, and the work is being delayed. For weeks past no perceptible progress has been made in Canal Street, where trade is practically at a standstill, because the thoroughfare is almost impassable. It seems that a difficulty has arisen with Mr. Shelton, timber merchant, who has extensive premises in the vicinity. The road was broken up a month ago, but nothing further was done. Then preparations were made to continue a double line across the railway bridge, but here Mr. Shelton stepped in and objected. He protested that he had been given no notice, and he pointed out that not only is the work seriously interfering with the traffic from his yard, but that a double line would deprive him of sufficient space to allow of the entrance and exit of vehicles to his works. He pointed out that the Committee was bound to leave a clear 9 ft. 6 in. space, whereas it was providing for only 2 ft. 6 in. The result was that the double line was countermanded, and the single track is now being proceeded with. But this did not end the troubles of the Tramways Committee. It had omitted to notify the Midland Railway Co. and the Canal Co. of its intentions with regard to the crossing to the goods station and the lines over the bridge, and the work at these two places has been suspended until a satisfactory understanding is arrived at. Alterations in plans and intentions have paralysed the progress on the route. The consequence is, that the condition of affairs on the Wednesfield Road is quite chaotic. The lines are being laid at different places between which there are blank spaces, which will remain untouched until satisfactory arrangements are made with various parties concerned.

TELEGRAPH AND TELEPHONE NOTES.

Italian International Telegraphs.—The Italian Administration announces the opening to International service of telegraphic communication between Asmara and Addis Abeba, connecting the Abyssinian stations Adue, Marcalle, Oufla, Marto, Borumieda, Ourro, Ailu, Ancober.

Swansea Telephones.—It is reported that a deadlock has arisen between the Swansea Corporation and the National Telephone Co. in regard to the inter-communication between the municipal service and that owned by the company.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Dominica-Martinique	May 5, 1902	
St. Lucia-Martinique	May 7, 1902	
Trinidad-Demerara No. 1	Aug. 27, 1901	
Cayenne-Pinheiro	Aug. 18, 1902	
Anjer-Kaliands	Aug. 2, 1902	
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1902	
Tourane-Amoy	Nov. 10, 1903	April 26, 1904
Tarifa-Tangier	Jan. 18, 1904	
Closed { Nagasaki-Vladivostock	Feb. 15, 1904	
Closed { Port Arthur-Chefu	Feb. 18, 1304	
Foochow-Formosa	Feb. 11, 1904	
Dakar-Conakry	April 11, 1904	
Landlines.		
Seoul-Masampo	Feb. 13, 1904	
Seoul-Gensan	Feb. 13, 1904	
Anju-Ping-Yang	Feb. 25, 1904	
Ninguta-Vladivostock	March 2, 1904	
Moulmein-Bangkok	April 23, 1904	April 13, 1904

Telegraph Cable Imports.—The value of the foreign telegraph cables and apparatus connected therewith imported into this country during March amounted to only £2,512, as compared with £2,985 in the preceding month, and £5,960 in March, 1902. For the first quarter of the current year the value of these imports has only reached a total of £9,246, or £13,752 less than in the corresponding three months of 1902.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—April 30th. Condensing plant, pump and piping. See "Official Notices" April 15th.

Aberdeen.—May 14th. Coal bunkers, and coal and ash conveyor. See "Official Notices" to-day.

Abergavenny.—May 24th. Electric lighting of Monmouthshire Asylum. See "Official Notices" April 22nd.

Ayr.—May 20th. Boiler, buildings, engines, dynamos, switchboard, wiring, mains, &c., for the District Lunacy Board. See "Official Notices" April 22nd.

Birkenhead.—May 14th. Feeder and distributing mains. See "Official Notices" to-day.

Bristol.—May 16th. One 750-KW. to 1,000-KW. single-phase turbo-alternator. See "Official Notices" to-day.

Canterbury.—May 14th. 1,800 yds. of cable. See "Official Notices" to-day.

Canterbury.—June 1st. Boiler, piping, 300-KW. steam dynamo, switchboard and economiser. See "Official Notices" to-day.

Cleckheaton.—May 2nd. 350-KW. steam dynamo. See "Official Notices" April 22nd.

Chili.—June 28th. Electric lighting of the city of Punta Arenas (Straits of Magellan). See this column for February 19th.

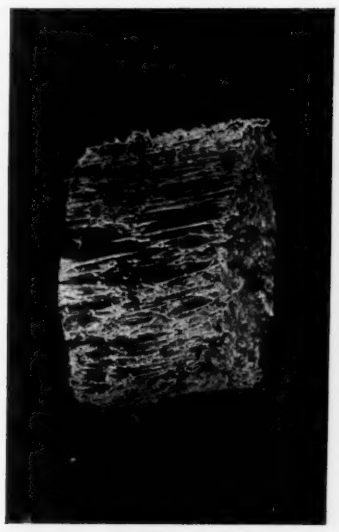
Clyde.—May 23rd. Electric wharf cranes for the Clyde Navigation. See "Official Notices" April 22nd.

(*Continued on page* 711.)

ASBESTOS AND ITS USES.

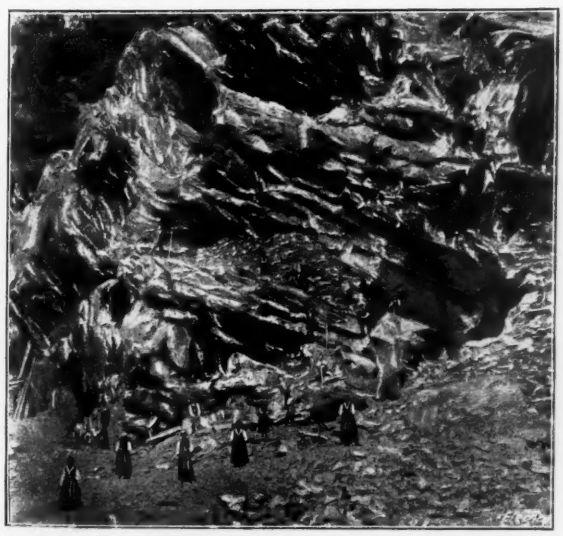
We recently visited the works of the United Asbestos Co., Ltd., and so interesting did we find the processes of treating asbestos, from the raw material to the finished article, that we feel it a duty to our readers to put them in possession of the very useful information which has been courteously placed at our disposal by the officials of the company.

Italian Asbestos in its Natural State.

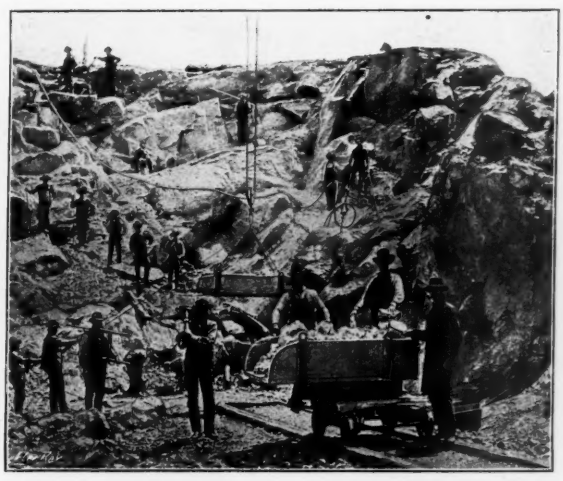


Canadian Asbestos in its Natural State.

The exigencies of space will not allow us to enter into the origin and history of the mineral, even if any useful purpose could be served by so doing; we do not intend to reproduce the hackneyed statements regarding the use of asbestos cloth by the ancient Greeks and Romans, but will at once plunge *in medias res* as they exist to-day. Asbestos is found in all quarters of the globe, but the only kinds so far found suitable for what may be termed universal commercial purposes are the Italian and Canadian varieties, although the Russian and South African specimens have their uses in a more limited field of operations.



"United" Asbestos Mines in Italy.



"United" Asbestos Mines in Canada.

Asbestos is a Greek word signifying unquenchable, unconsumable, eternal. The material is a variety of hornblende, and is a mineral substance, the chemical constituents of which are chiefly silica and magnesia.

It may be interesting to give the chemical analyses of the two qualities which are chiefly dealt with in the asbestos industry—viz., Italian and Canadian. These are as follows:—

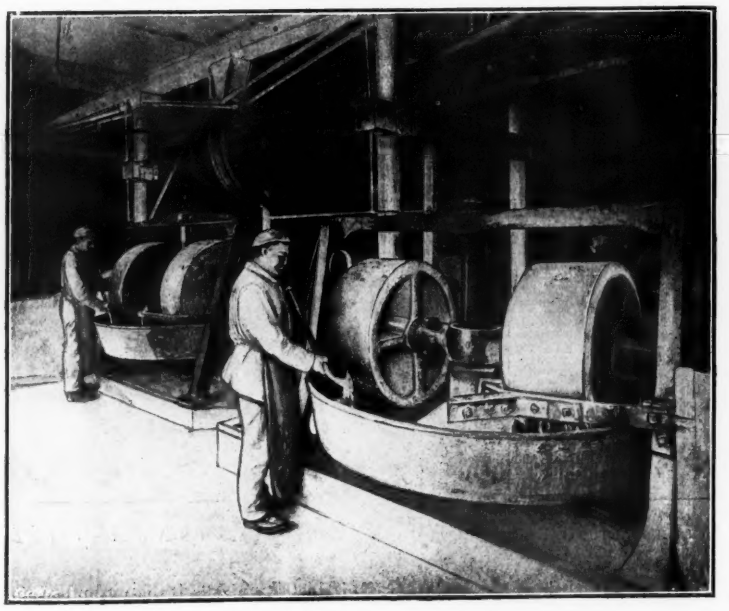
	Italian.	Canadian.
Magnesia	38	33
Silica	42	41
Oxide of iron	3	5⅜
Potash	1	—
Soda	1½	⅜
Alumina	2⅓	7
Moisture evaporated at 100° C.	3	—
Losses on heating to white heat	9	12⅛
	100	100

The peculiar characteristics of this wonderful material are that it is fibrous, fireproof, an insulator of electricity, a non-conductor of heat, and proof against acid to a very large extent.

It was reserved for some enterprising Scotchman to bring asbestos before the notice of engineers in this country, and

in this connection the name of the late Mr. Walter McLellan, of the well-known Glasgow engineering firm, is associated. This gentleman, with Mr. H. R. Robson, of Glasgow, was engaged for several years in investigating the asbestos industry, with the result that, having satisfied themselves as to the commercial value of the mineral, they formed a company in 1871, called the Patent Asbestos Manufacture Co., Ltd., established works in Drummond Street, Glasgow, and commenced operations.

A few years later a competing firm called "The Italo-English Pure Asbestos Co.," of London, came into existence, backed by powerful influence, with extensive mining rights, and a manufactory in Turin. A keen struggle for supremacy commenced, and in the year 1880 the rival concerns were amalgamated by the formation of "The United Asbestos Co., Ltd.," under the presidency of Sir James Allport, of the Midland Railway. Fresh competitors were soon in the field, and obtained a share of the trade opened up by the enterprise of the pioneer company. It was found desirable to concentrate the manufacture hitherto carried on in the old works at Glasgow, Turin, and Tivoli, near Rome, and extensive works were secured on the canal bank and River Colne at Harefield, where asbestos goods, in all the forms in which they are now offered to engineers, are manufactured.



Preparing and Crushing Asbestos

Geographically, the mills are situated on the water-shed, which converges on the Thames at a point where the Rivers Colne and Gade flow in one channel, which also, for a certain distance, carries the Grand Junction Canal. These two rivers, with smaller tributaries, all pass through the works of the United Asbestos Co. at Harefield Valley.

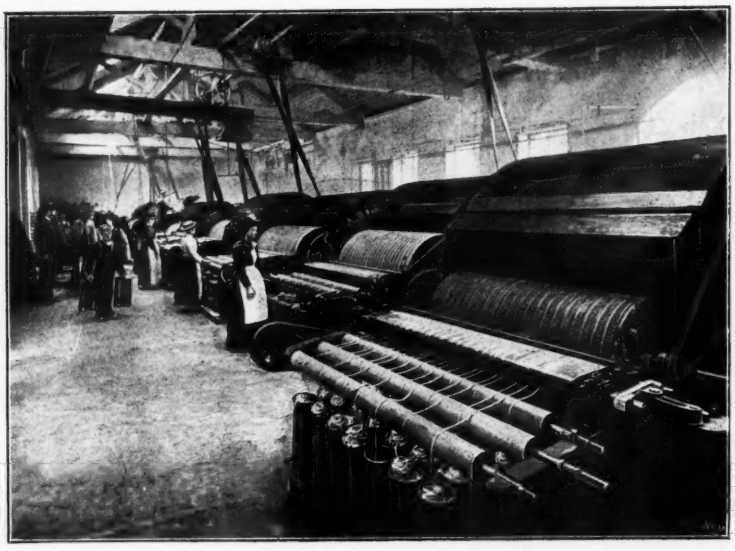
Before they reach this point, they pass through other mills in a more or less scattered form, and some distance below Harefield Mills they are again broken up into a number of other streams, rendering service to various paper and corn mills above and below Harefield. The whole collective power of these various streams is concentrated at Harefield Mills into one powerful river, which at this point has a fall of 6 ft.

This natural power is utilised by the United Asbestos Co., distributing it over three large water wheels, which, when water is plentiful, can develop 100 H.P. This is one of the reasons why such a large factory has been put down so far out of the beaten track.

The business of the United Asbestos Co. has, however, grown to such an extent, that steam power has had to be utilised in addition to water-power, and three steam engines are at work in addition to the three water wheels, bringing up the aggregate motive power of water and steam combined to about 300 H.P. Although the position of the mills is somewhat out of the way for some purposes, all the coal used is brought direct from the coal pit, right alongside the boilers, and within a few feet of the furnaces.

The self-contained nature of the works is further evident from the fact that all the gas used is made on the premises, and a powerful Merryweather steamer is ready at any moment in case of fire.

Italian asbestos has been found at an elevation of about 7,000 to 10,000 ft., and the principal work has been carried on at an elevation of about 5,400 ft. The method of working is to follow the veins on the surface, which run into the rock in a downward or upward direction, and finally converge to a centre where a pocket of as much as a ton or a ton and a half of asbestos may be obtained by blasting the rock with dynamite. The asbestos has then to be carried by men or on mules or in small trucks to the roadway, and from there by the nearest railway for transport to Genoa, from which place it is shipped to the Thames and thence by canal to the company's works at Harefield.



Carding and Condensing Asbestos.

The Val d'Aosta mines lie north of Turin and Ivrea. The best qualities are found in the Vale of Challand (where gold is now being mined in paying quantities) and Val Tournanche leading up towards the Matterhorn.

Grey fibre, suitable for spinning into thread, weaving into a cloth, and plaiting into rope or packing, also for making into asbestos millboard and paper, is found in both the districts of Valtellina and the Val d'Aosta, but floss asbestos, the quality which is most generally known to the public by its use in gas stoves, for which it is most suitable on account of its great resistance to heat, is found in the Val Susa, near Turin. This quality cannot, however, be used for spinning purposes, as it is too weak in tensile strength. Asbestos in the form of a fibrous powder is also

found in the same district, and this has been made into a fire-proof paint, which has been used for fire-proofing wooden structures in all parts of the world. The seam of powder, 3 ft. wide × 1 ft. deep, was discovered through a landslip almost at the base of the mountain where the mine is situated.

The formation of the United Asbestos Co. gave an impetus to the search for asbestos in other parts of the world, and as it was known in 1868 that a similar fibrous mineral was found in Canada, in the province of Quebec, preparations were made to commence mining operations there on a considerable scale. The fibrous mineral found in Canada in the serpentine rock is technically called chrysotile, but its chemical composition is very similar to the hornblende variety, and has similar physical properties.

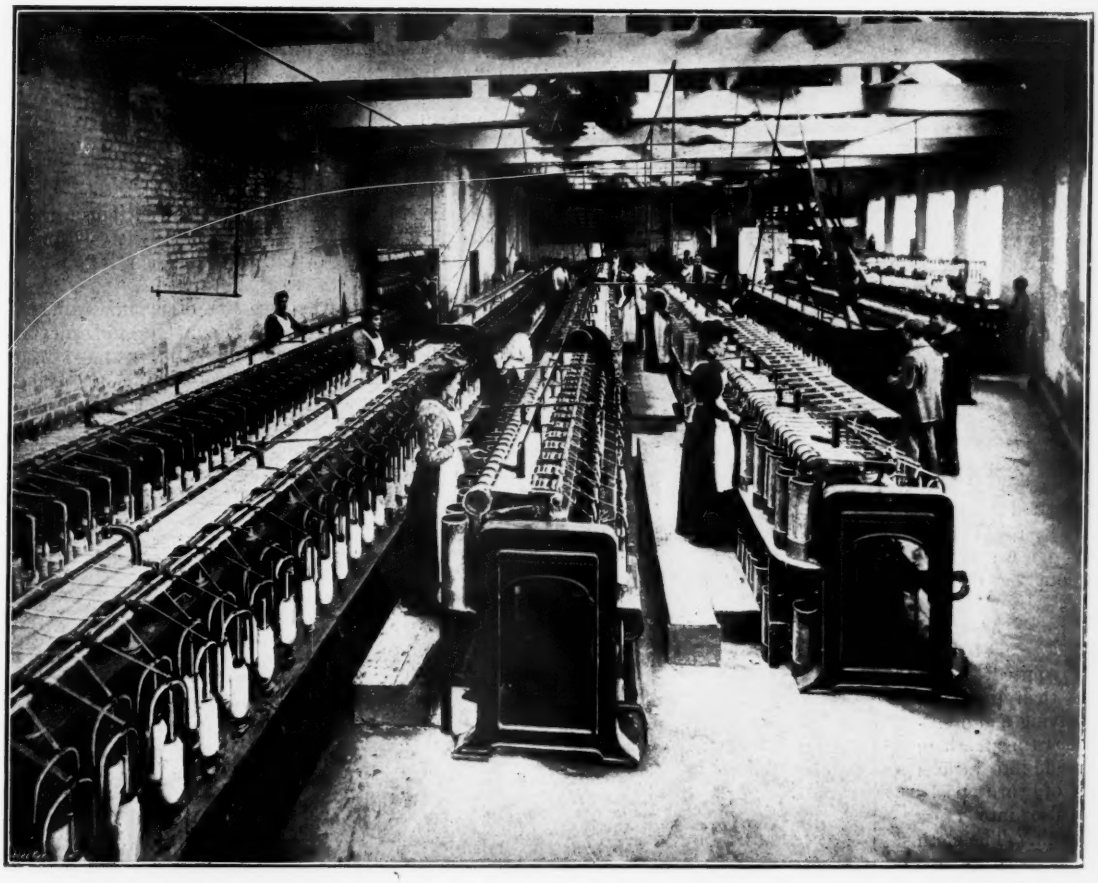
The immediate locality where the best qualities are obtained lies in the eastern township on the line of the Quebec Central Railway, half way between Quebec and Sherbrook and north of Montreal. The formation is metamorphic, and the asbestos is obtained from a belt of serpentine, extending on the north-east from the township of Broughton to Ham on the south-west, and including Thetford Coleraine and others. The mining here, as shown by the illustration, is not conducted under the same difficult conditions as in Italy; the district being more favourable on account of its lower altitude. The operations are carried on by means of drills worked by compressed air, and other machinery, and these circumstances, together with the ready and cheap transport, and the fact that a larger proportion of fibre to the matrix is found in Canada, reduces the cost of the Canadian fibre very much. In both Italy and Canada, the fibre is separated from the rock and classified into three qualities, before shipment. In Canada the veins of the fibre run through the rock in all directions, and at different angles. Sometimes these are parallel and divided by thin layers of rock, in which is found a great deal of chrome ore.

Now that the demand for asbestos has increased, a considerable quantity of asbestos is being exported from Russia from the district of Ekaterinburg, in the Ural Mountains. Russian fibre is sharp and prickly, and before manufacture it requires to be mixed with longer and more suitable fibre.

There is also the South African blue fibre, known to the mineralogist as crocidolite. It is found in extensive deposits in Griqualand West, Cape Colony, on the banks of the Orange River. It differs from Italian and Canadian, mainly in that it is a silicate of iron instead of a silicate of magnesia. One analysis gives :—

Silica	50
Oxide of iron	40
Alumina	6
Magnesia	2
Volatile matter	—
Loss on ignition	2
	100 per cent.

It generally runs longer in fibre than Canadian, and the fibres are stronger and lighter, nevertheless it is not quite so easy to manufacture.



Spinning Asbestos.

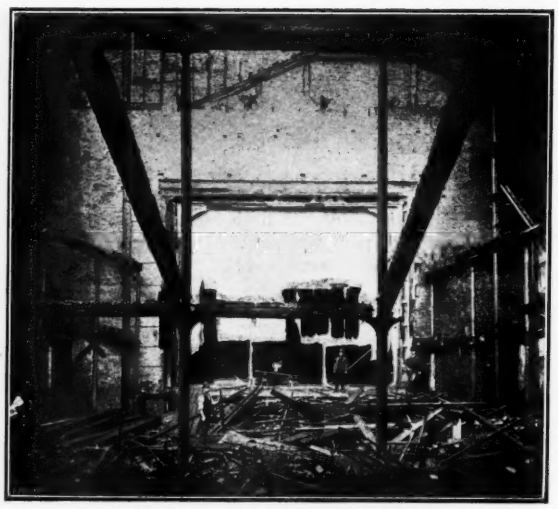
On account of its containing about 40 per cent. oxide of iron, it is not suitable for many purposes for which asbestos is required.

The machinery and plant in the Harefield Works are of the most remarkable and complete nature, and would occupy much time to even attempt to describe them. Moreover, as recent improvements have been effected in the mode of treatment, our readers will understand that we must exercise a little reserve in dealing with this part of the subject.

We will briefly state the process of manufacture, and in so doing, will refer mainly to the Canadian asbestos. The Italian fibre is more difficult to deal with, and requires special machinery.

The works are divided into several departments. First there is the sorting and opening department, where the crude asbestos is dealt with. The blocks of fibre, or "rock," are crushed and opened up in special machines in such a way as not to destroy the fibre, and are passed thence to "shaking" machines, where the long fibre is separated from the short, and particles of rock removed. The long fibre suitable for

spinning into thread is then taken into the carding and condensing department, and the short to the millboard and boiler-covering departments. The treatment of the long fibre in the carding and condensing department is very similar to that in a textile factory, but its appearance would be scarcely encouraging to one who had been accustomed to wool or cotton. These latter staples, examined under the microscope, exhibit a notched or serrated appearance, which explains the ready way the material clings together when twisted. The peculiar nature of asbestos presents difficulties which are rendered more evident when its behaviour in the machines is watched, but these difficulties are overcome by special appliances attached to the condensing machines. As the fibre comes from the condensers in the form of silver or condensed thread without any twist, it lightly folds itself in cans placed there to receive it, and is then taken to the spinning and doubling department, where it is twisted into threads of every degree of fineness required. The thread then passes to the weaving and braiding department, where it is made into various forms of yarn packings, also into tapes and cloth. The cloth is then taken to the indiarubber department, where it is proofed and made into what is known as asbestos and indiarubber woven sheeting, tape and rings for steam and other joints, and also into rolled cloth and square block packings for glands.



Queen's Theatre, Manchester, after Fire, August 17th, 1890, showing the "Victor" Fireproof Drop-Curtain by which the Stage and Scenery were Saved.

Recognising that in these days of fast steaming and high pressures it is of supreme importance to marine engineers that they shall have jointing and packing materials upon which they may place reliance, the company produced some years ago a combination of asbestos and metallic wire which, with further improvements recently effected, fully answers expectations. Attempts had been previously made in this direction, but the results were not considered satisfactory, inasmuch as the asbestos metallic cloth was simply woven either with a wire warp and asbestos weft, or with alternate threads of asbestos and wire. There is now enclosed, by an improved method recently adopted, a fine brass wire in the centre of every thread of asbestos in both warp and weft, thereby adding very largely to the strength of the cloth, while the wires are completely protected by the asbestos. This material is known as the "Victor" metallic cloth, and, being made into tapes and all sizes and shapes of joints, as well as into round and square packings, is now largely used, with satisfactory results, by marine engineers and others.

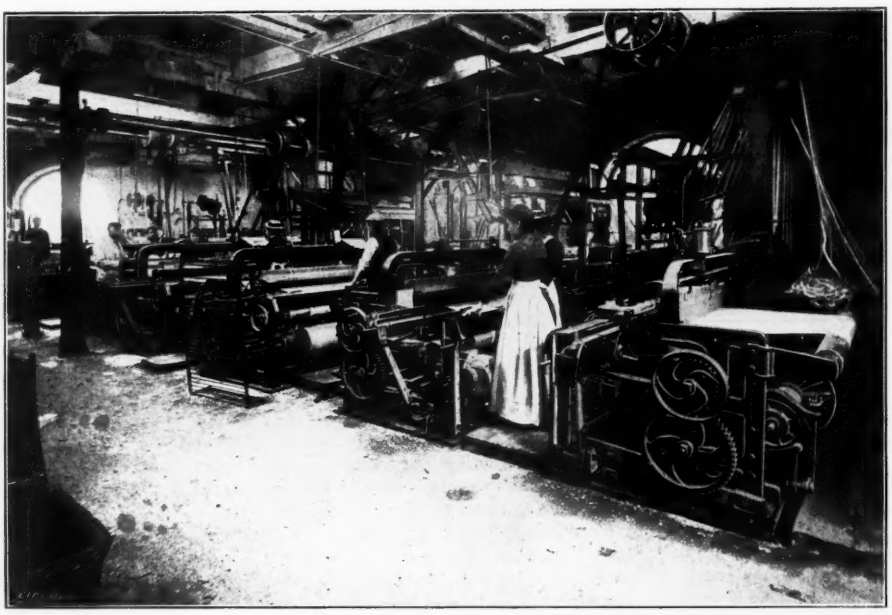
So dense and close can joints be made from this material that it is being largely supplied for hydraulic work, and small rings have been tested up to pressures of 2,500 and 3,500 lbs. to the square inch.

Another form of joint is the "Salamander" joint, which has been patented. These joints have two concentric rings made from the metallic cloth to which we have just referred. The rings are sustained by a suitable metal ring, the vertical wall in the centre of which forms a partition between them, and absolutely prevents the possibility of displacement by either steam or moisture. By this arrangement, in fact, a *double* self-sustaining joint is made in place of the ordinary one.

We have just referred to the "Victor" metallic cloth, and may add that so far as its heat-resisting properties are concerned this is clearly demonstrated by a fire which entirely destroyed the auditorium of the Queen's Theatre at Manchester in 1890. The stage had been fitted with one of the company's patent metallic asbestos curtains; the fire originated in the auditorium and raged fiercely for several hours, but the whole of the stage and contents were saved by the curtain.

Turning again to the processes of manufacture at Harefield, we said that in the sorting and opening department the long fibre suitable for spinning is separated from the shorter fibre suitable for millboard and boiler covering, and this brings us to the millboard department.

The manufacture of asbestos millboard is somewhat similar to that of ordinary cardboard. After some preliminary treatment, the asbestos fibre is run with water into the tanks of beating engines. Each of these tanks is provided with a rotating beater, which maintains a thorough circulation, taking up the fibre, opening and drawing it out, and then sending it forward to be soaked for a time until it comes round again to the beater. The binding ingredients are here added and thoroughly mixed with the fibre, when the pulp is passed into the vat of the millboard or paper machine, where it is kept in a state of agitation until



Weaving Asbestos Cloth.

gradually drawn off. The water passes through a fine wire gauze on a revolving cylinder, leaving a thin coating of pulp on the cylinder. This is then transferred by means of an endless band to a second rotating cylinder, where it gradually accumulates until the desired thickness has been reached. It is finally cut across and removed in the form of a square sheet of millboard. As the sheets contain a large percentage of moisture, they are next placed between sheets of zinc and passed under hydraulic pressure and then hung in drying rooms. They are then again pressed and their edges trimmed, when their manufacture is complete.

In this process the chemical composition of the asbestos undergoes little if any change, and excepting the binding materials which have been added, chemical analysis shows the composition of the best millboards to be practically the same as the fibre from which they are made.

We now come to the boiler-covering department, where the short fibre and powdery asbestos is worked up with other suitable ingredients into a non-conducting composition for covering steam boilers and pipes. Great improvements have been effected in this composition in recent years, and the company ventures to assert that, with proper manipulation and application, asbestos composition will compare favourably with any other known material as regards its power as a non-conductor of heat, while its indestructible nature is certainly a point worth consideration.

The subject of covering steam boilers and pipes has, however, been brought into special prominence by the rule of the Board of Trade, that all steam pipes and boilers of marine engines shall be tested by hydraulic pressure to double the working pressure at certain intervals. Before testing the pipes the lagging must be removed; but it is, we believe, within the discretion of the Board of Trade surveyor whether or not the lagging of the boilers shall also be removed before testing.

This rule points to the desirability of producing a satisfactory removable boiler and pipe covering. The idea of making quilts or mattresses composed of asbestos cloth filled or stuffed with non-conducting material is not new, for this was done by the company years ago for non-conducting purposes. But the way in which these quilts or mattresses were prepared was somewhat defective, as the fibre or other material with which they were filled shifted its position, the result being that some parts of the mattress became choked and other parts empty.

This defect has now been removed by a simple arrangement which has been protected.

The weight of the covering is only 1½ lbs. to the square foot; it is easily applied, and may be removed and replaced without trouble. It has been carefully tested as a non-conductor, and found to give excellent results. Several mattresses of this class have been already supplied to shipbuilders in this country. The surface can either be painted, or can be covered with sheets of zinc. The latter has been done in some cases.

Asbestos paints, in which a considerable quantity of asbestos powder is used, were patented and introduced in November, 1881, and are of two principal kinds.

First, asbestos fireproof paint, suitable for rough woodwork, such as joists, rafters, beams, stairs, warehouses and wooden structures of all kinds. Numerous public experiments have been carried out from time to time, proving the remarkable fire-resisting qualities of this paint, the first being conducted under the patronage of the Lord Mayor and a distinguished company at the Crystal Palace in January, 1882. Nearly 150 tons of the material were used on the building of that and the Fisheries, Health, and Inventions Exhibitions held in 1883-4-5-6.

At each of these Exhibitions several small fires broke out at exhibitors' stalls, which might have proved very serious but for the protection afforded by the paint. There was one in which the fire occurred at a stall in a remote part of the buildings at four o'clock in the morning. The stall and its contents were destroyed, and the wooden floor of the building burnt through; but the wooden partitions against which the stall stood, as well as the roof, both of which were painted, were scarcely injured. The paint was badly blistered, but the painted wood had not taken fire, as it doubtless would have done under ordinary conditions and probably with disastrous results.

If we were to refer to the numerous other articles into which asbestos is manufactured it would become wearisome reading. Twelve years ago only three or four distinct kinds of goods were made; now the company turn out over 100 varieties. Asbestos 25 years ago was practically only known in the laboratory of the chemist or mineralogist. It now finds its way in one form or another into almost every workshop where steam is employed.

Finally, we have to thank Mr. J. Alfred Fisher, the general manager, Mr. Joseph Hawkridge, the assistant secretary to the company, and Mr. McCallum, the works manager, for their cordial co-operation in the preparation of this article.

CONTRACTS OPEN.

(*Continued from page* 706.)

Deptford.—The B.C. on Tuesday decided to call for tenders from six firms for wiring and plain fittings for the new Town Hall and municipal buildings; Messrs. Medhurst & Lloyd, the consulting electrical engineers, estimate the cost at £710. The draft, general conditions, drawings, and specifications for (1) the provision of steam dynamos and booster; (2) alteration to the battery; (3) switchboard and connections; and (4) steam piping work, were submitted, but the consideration of them was postponed, pending the Committee having a conference with the engineers respecting details. Messrs. Medhurst & Lloyd were instructed to prepare a specification for the provision of internal telephones.

Dublin.—May 9th. Steam three-phase extra high-pressure set (1,000 to 1,500-KW.), piping and switchboard. See "Official Notices" April 15th.

Dundee.—April 30th. General stores, electrical goods, &c., for the Electricity Department. See "Official Notices" April 22nd.

Glasgow.—May 9th. Four sets of 800-KW. dynamo panels for the Electricity Department. See "Official Notices" April 22nd.

Glasgow.—May 23rd. Main cables and electricity meters. See "Official Notices" to-day.

Hackney.—May 26th. Electricity supply mains. See "Official Notices" April 22nd.

Hammersmith.—May 18th. Two 1,500-KW. steam turbines or low-speed engine generating sets, with condensers; boilers and superheaters. See "Official Notices" April 15th.

Holland.—May 31st. Tenders are being invited until May 31st by the Municipal Authorities of Utrecht for the supply and laying of the armoured mains in connection with the municipal central electric lighting station.

Ilkeston.—May 7th. Advertising on the electric cars. See "Official Notices" April 22nd.

Italy.—August 18th. Tenders are being invited until August 18th next by the municipal authorities of Amelia (province of Umbria) for the electric lighting of the town.

Kilmarnock.—May 17th. Permanent way work. See "Official Notices" April 15th.

London.—May 4th. The May-Oatway Fire Appliances, Ltd., is inviting tenders for wiring certain buildings on its system. See "Official Notices" to-day.

L.C.C.—May 17th. Extra high-pressure three-phase board, low-pressure combined direct and three-phase ditto, sub-station and transformer boards for Greenwich power station. See our "Official Notices" April 15th for particulars.

L.C.C.—May 17th. Ten water-tube boilers with superheaters. See "Official Notices" to-day.

Manchester.—May 25th. Twenty movable electric cranes, for the Ship Canal new dock works. See "Official Notices" to-day.

Melbourne.—May 13th. One 750-KW. direct-current steam dynamo. See "Official Notices" March 18th.

Natal.—May 9th. Electric telpherage system for Bonded Warehouse. See "Official Notices" March 18th.

Neath.—May 16th. Electric light mains, feeder pillars, and switchboards. See "Official Notices" to-day.

Poplar.—May 7th. Cables and battery. See "Official Notices" April 22nd.

Royton and Crompton.—April 30th. Permanent way. See "Official Notices" April 8th.

Southampton.—May 11th. Arc lamps, motors and service cable. See "Official Notices" to-day.

Spain.—May 8th. The Municipal Authorities of Moral de Calatrava (province of Ciudad Real) are inviting tenders until May 8th for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Moral de Calatrava (Ciudad Real).

Spain.—June 15th. Tenders are being invited until June 5th by the Spanish Ministry of Posts and Telegraphs for the maintenance and working during a period of 5 years of the existing submarine telegraph cables between (1) Cadiz and Teneriffe of the Canaries; (2) between Barcelona and Mallorca; (3) between Ceuta and Tangiers; (4) between Chafarinas and Nemours, and for the repair of the cable between Tarifa and Tangiers.

Stoke-upon-Trent.—May 13th. Meters, demand indicators, and house service cut-outs. See "Official Notices" to-day.

Wallasey.—May 7th. Condensing plant. See "Official Notices" April 15th.

Walthamstow.—May 20th. Tramcars. See "Official Notices" to-day.

CLOSED.

Battersea.—The B.C. has accepted the following tenders:—

Babcock & Wilcox, Ltd., for extension pipework and ejector condenser at the Central Generating Station, at £1,119.
Callender's Cable & Construction Co., Ltd., cables, &c., for stock at schedule prices (estimated at £2,624), and street boxes (estimated at £508 16s. 8d.).
Walsall Electrical Co., Ltd., for an additional panel to the main switchboard, at £179.
W. T. Glover, Ltd., for cable to connect the main switchboard with the new machinery, at £86 18s.
General Electric Co., 100 globes for arc lamps at 6s. 9d. each.
Belliss & Morcom, Ltd., to purchase from the Council at £270 a disused engine and dynamo.

Brighton.—The T.C. has received the following tenders for dry-core lead-covered telephone cables for the extension of the system:—

British Insulated & Helsby Cables	£2,613
Western Electric Co.	2,625
Henley's Telegraph Works Co...	3,031

Broughty Ferry.—The St. Helen's Cable Co. has received a large order from the Corporation for Dialite insulated cables.

Brush Car Contracts.—The Brush Electrical Engineering Co. has secured the following contracts:—

Worcester Tramways.—Seven cars, complete with motors and trucks.
Canvey Island.—(Per Bruce Peebles & Co.), four cars and trucks.

Bury.—The British Westinghouse Co., Ltd., has just booked a further order from the above Corporation for its magnetic brakes to be fitted to 25 cars, 12 single-truck and 13 bogie cars, all mounted on Maguire trucks. We understand that this order covers all the cars not already fitted with magnetic brakes.

Dundee.—The Tramways Committee has recommended the acceptance of the following tenders:—

Meters.—Chamberlain & Hookham, Ltd.
Coal.—R. L. Ireland & Co., Dundee (4,000 tons, Larrodie Mill, Dross).

Glasgow.—In connection with the Pollokshaws Road station, Messrs. Richardsons, Westgarth & Co., Ltd., have received an order for one large cooling tower for the centre water tank at a cost of £1,973 10s., and the Klein Engineering Co., Ltd., an order for two cooling towers for the end water tanks at the sum of £1,289 each.

The offer by the British Thomson-Houston Co., Ltd., to provide and erect at the Port Dundas station six high-tension transformers in connection with two of the existing dynamos of their own make, and to alter the dynamos so that they may produce alternating as well as continuous current, has been accepted. The price is £2,398.

The Electricity Committee has recommended the acceptance of the following offers:—(1) Messrs. Witting, Eborall & Co., London, for the switchboards required for the Port Dundas station, the amount of the contract being £5,200; (2) British Westinghouse Co., Ltd., for the switchboards required for the Waterloo Street and other sub-stations, the amount of the contract being £3,081; (3) Doulton & Co., Ltd., for the earthenware ducts, the amount of the contract being estimated at £400.

Messrs. Babcock & Wilcox, Ltd., have received the contract for providing and erecting four water-tube steam boilers and mechanical stokers at Port Dundas station, and three boilers and stokers at Pollokshaws Road station. The amount of the contract is £11,799.

The sub-committee of the Cleansing Department recommends that the offer of Messrs. W. Harvie & Co., Ltd., Glasgow, for the electric light installation at Crawford Street works and stables be accepted. The amount of the offer is £936 7s.

Messrs. W. C. Martin & Co., electrical engineers, Glasgow, are recommended for the contract for fitting up the installation of electric light in Partick sewage works, and the British Electric Plant Co., Alloa, for the dynamo contract. The former contract amounts to £509, and the latter to £127.

Hanley.—The T.C. has accepted the following tenders for plant at the E.L. works:—

British Westinghouse Co., Ltd., 500-kw. steam alternator	£3,162
Bertrams, Ltd., condensing plant	495
A. Bolton & Co., Manchester, superheaters	389

Ipswich.—The Corporation has placed with Messrs. Reavell & Co., Ltd., on the recommendation of Messrs. Kennedy and Jenkin, an order for a further extension set of 800-h.p. This is the largest engine yet undertaken by the firm. The Ipswich tramway and lighting station is already equipped with six of their engines, and a seventh, of 500-h.p. is in course of construction. This further engine of 800-h.p. is to be directly coupled to a 500-kw. generator by the Electrical Co., of Charing Cross Road. Messrs. Reavell are constructing this new engine on the same general lines as their smaller engines, but the surfaces throughout are of very ample proportions, so that with suitably proportioned cylinders, this new unit may be used for powers up to 1,000 h.p. We understand that the generating sets already at work at Ipswich, for traction and lighting, are giving excellent results.

Lancaster.—For the execution of the whole of the work and the supply of the material for the new tram route from Dalton Square to the L. & N.-W. R. (Castle) Station—a distance of about half-a-mile—and also doubling the existing line in South Road, Messrs. R. W. Blackwell & Co.'s amended tender of £10,259 has been accepted.

Lincoln.—The Corporation has accepted Messrs. Bruce Peebles & Co., Ltd.'s, tender for the supply of a 200-kw. steam generating set.

London.—The London County Council has accepted the offers of Messrs. Siemens Bros. & Co., and the British Insulated and Helsby Cables, Ltd., respectively, to supply and lay at the schedule rates of their existing contracts, high and low-tension cables for the working of certain short lengths of tramways in Southwark and Bermondsey. The estimated expenditure amounts to about £15,000. The Council received the following tenders for the supply of three motor-generators for use in connection with the working of the Southwark tramways:—

Name of firm.	Amount of tender.	Time for delivery.
British Thomson-Houston Co.	£4,837	20 weeks.
Dick, Kerr & Co. (accepted)	5,150	12 "
British Westinghouse Co.	5,492	12 "

The offer of Mr. Bertram Thomas has been accepted for additional switchboards for the Elephant sub-station for the sum of £410.

Loughborough.—The T.C. has accepted the tender of Messrs. Pritchetts & Gold, Ltd., for £1,100 (annual maintenance £65) for the battery for the electrical undertaking for the borough.

Poplar.—There was an error in last week's list of tenders. Under the heading "Motor Generators" it was stated that Messrs. Bruce Peebles & Co.'s tender at £9,060 10s. was accepted. It was, however, that firm's alternative tender for Le Cour motor converters that was accepted at £7,815 10s.

Stepney.—The tender of Mr. B. E. Nightingale at £12,921 has been accepted for building the extension to the B.C.'s generating station.

War Office.—The Secretary of the Army Council has placed with the Sir Hiram Maxim Electrical & Engineering Co., Ltd., a contract for the supply of electric telescope lamps mounted in ebonite sockets.

Woolwich.—The B.C. has accepted the tender of the British Thomson-Houston Co., Ltd., for the supply of B.T.H.-Edison electric lamps for the ensuing year.

FORTHCOMING EVENTS.

Saturday, April 30th.—At 10 a.m. Institution of Electrical Engineers (Students). Visit to the Western Electric Co.'s works at North-Woolwich.
Association of Engineers-in-Charge. Bohemian Concert.
Monday, May 2nd.—At 7.30 p.m. Society of Engineers. "A Jubilee Retrospect" of the Society, by Mr. P. F. Nursey. "British and American Coal-Cutting Machines," by Mr. A. S. E. Ackermann.
Wednesday, May 4th.—At 7.30 p.m. Institution of Electrical Engineers (Students). "Alternating Current Commutator Motors," by Mr. F. Creedy.
At 8 p.m.—Society of Arts. "Statistics of the World's Iron and Steel Industries," by Mr. W. P. Digby.
Thursday, May 5th.—At 2.30 p.m. Institution of Electrical Engineers (Students). Visit to the Electrical Power Storage Co.'s works at Milwall, E.
At 5.30 p.m. Röntgen Society (Medical members). "Three Years' X-ray Work," by Dr. L. H. Harris.
At 8 p.m. Civil and Mechanical Engineers' Society. "Pumping Engines," by Mr. C. L. Simpson.
At 8.30 p.m. Röntgen Society. "The Röntgen Society; Its past Work and future Prospects," by Mr. J. J. Vezey; "Some Experiments with Alpha Rays," by Mr. F. H. Glew.
Friday, May 6th.—At 8 p.m. South-Western Polytechnic, Manresa Road, S.W. Distribution of prizes and certificates to the students by Earl Cadogan, K.G. [The conversazione will be held the following night, Saturday, from 7 to 10 p.m.]
At 8 p.m. Tramways and Light Railways Association, at the Society of Arts. Topical discussion on "Running Powers," introduced by Mr. Thos. W. How, F.G.S. (Member of Council).

NOTES.

Obituary.—We regret to announce the death of Mr. Russell Oswald Wright, which took place on the 13th inst. at his residence, Oak Cottage, Urmston Lane, Stretford, Manchester. The deceased gentleman was a senior partner in the firm of Messrs. Wright & Methuen, electric and power engineers, of Pall Mall, Manchester, and had considerable local reputation. He was associated with the wall paper combine at Darwen, and went to Manchester as electrical engineer to the Fine Cotton Spinners' Association, in which position he had charge of many important installations at factories and mills. He finally relinquished that post to go into business on his own account.

We learn, with regret, of the death, which occurred on the 12th inst., of Mr. T. J. Wilmot, who had been for 19 years superintendent of the Commercial Cable Co.'s station at Waterville. Mr. Wilmot was 52 years of age. The funeral left the superintendent's quarters punctually at noon, and by order of the vice-president of the company—G. G. Ward, New York—traffic on the entire system of the company was stopped, as a mark of respect, for five minutes, while the remains rested outside the deceased's office and the staff on duty left the building and paraded before the coffin. There was a very large gathering of cable men and other friends present at the funeral.

Messrs. Wheatley Kirk, Price & Co. desire to express their grateful thanks for the numerous expressions of sympathy which have reached them on every side, on the occasion of the recent sudden decease of Mr. S. Sherley-Price, one of their junior partners. The great number of communications precludes individual replies.

London County Council.—At the meeting on Tuesday the Council resolved to lend £10,249 to the Battersea Borough Council for mains, machinery and other works, and to sanction the borrowing by the Stepney Borough Council of £57,650 for the extension of station and plant.

The Highways Committee reported having had under consideration the question of the reconstruction for electric traction of the tramways acquired from the South London Tramways Co., and situated mainly in Battersea and Wandsworth. A definite decision as to the system of traction to be adopted for all the lines in question had not yet been arrived at, but it would be necessary to provide plant, &c., for either the underground or overhead method, and the Committee proposed to purchase, for £4,500, a site at East Hill for the purpose of a sub-station.

The Committee further stated that the Metropolitan Electric Supply Co. had submitted a notice of intention to lay extra high tension mains along Newman Street, Oxford Street, and other thoroughfares. It was understood that, owing to the very large number of pipes and wires already laid under Oxford Street, it would be both inconvenient and dangerous to place further lighting mains of such high voltage as proposed. The company was in communication with the St. Pancras Borough Council with a view to obviate the necessity of interfering with Oxford Street, and as such an arrangement would be a great improvement on the company's present proposal, the Committee had disapproved the projected works, and the company would, therefore, be able to forward an amended plan and notice.

Electrical Power in Weaving Mills.—At a recent meeting in Manchester, of the British Association of Managers of Textile Works, presided over by Sir Frank Forbes Adam, Mr. T. A. Carver, of Glasgow, discussed the possibilities of electric energy in textile processes. In his opinion there is a very wide field for the application of electro-mechanics to weaving. Electricity, he said, was the most beautiful means known for the transmission of energy, and its advantage was especially apparent in weaving, where a great number of things are happening, at one time, at different parts of the same machine. The different branches of engineering have not, he considers, up to the present, been sufficiently correlated. Wherever electrical working has been successfully applied in engineering, it is fulfilling one purpose, namely, the transmission of energy from the point of generation to the point where it is required, in a manner surpassing in simplicity all other means whatever. Mr. Carver explained the working of the electric warp stop, weft stop, &c. The importance was urged of co-operation between mill managers and scientific engineering enterprise.

James Watt Memorial.—The people of Greenock have set on foot a scheme for establishing a James Watt memorial in their town, and are now inviting subscriptions.

Tramway Running Powers.—On Friday, May 6th, at 8 p.m., there is to be a discussion on this, the question of the hour, before the Tramways and Light Railways Association, at the Society of Arts.

Prize for Essays on the Decimal System.—The Executive Committee of the Decimal Association is offering prizes of £20 and £10 for the best and second best essays on the advantages to be gained by the adoption of the metric weights and measures throughout the British Empire, and on the best means for effecting the transition. The essays are to be sent in on or before January 1st, 1905, to the secretary, Oxford Court, Cannon Street, E.C.

Workmen's Compensation.—At the Royal Statistical Society, last week, a paper on "Five Years' Experience of the effect of the Workmen's Compensation Act, with special reference to schemes certified thereunder," was read by Mr. W. H. Tozer.

A Brilliant Reflection.—In the *St. James's Gazette* of Tuesday last, a sapient paragraphist who styles himself "one" inquires whether "one's" readers have ever tried a new reflector for electric lights, made of silvered glass. The Improved Glow Lamp of several years' standing has apparently not yet shed its brilliance upon "one's" desk, but the reflector in question is credited with doubling the illumination thereon. Unfortunately, it leaves the bookshelves in darkness. "One" goes on to say:—"Cannot some ingenious man give us a similar shade *so shaped that the light may be diffused?*" (The italics are ours.) "With half the quantity of light properly diffused, a good deal better result would be obtained." "There is a fortune for somebody in this idea, properly worked out." What the last three words exactly mean, we do not know; but as for the idea, "one" seems to think that because one finds the concentration of diffused light to his taste, one would equally benefit by the diffusion of the light so concentrated. "One" can't have it both ways! If "one" were to confine his reflections to the composition of interesting paragraphs, and leave highly technical subjects to those qualified to deal with them, "one" might avoid such elementary errors as the one here quoted, to say nothing of the improper use of "and which."

Kettering Electricity Works.—The municipal electricity works are to be formally opened on May 7th.

For Sale.—Taunton Corporation is open to dispose of an "Economic" boiler. See "Official Notices" to-day.

Electrical Volunteers' Concert.—On Saturday, May 14th, at 8 p.m., the Electrical Engineers (R.E.) Volunteers are holding a Bohemian Concert at the headquarters, Regency Street, Westminster.

Electrical Winding.—At the annual general meeting of the South Wales Institute of Engineers, the £20 prize offered by Sir W. T. Lewis annually for the best paper sent in upon a given subject, was awarded to Mr. H. B. D. How for a paper on "Electrical Winding." The president-elect, Mr. E. H. Hann, of the Powell-Duffryn Colliery Co., afterwards delivered his presidential address, in which he outlined the mechanical improvements which have been effected during the past 34 years in colliery working. Referring to the rapid development of electrical installations of the past few years, the president said groups of collieries evidently offered a more promising field for a heavy supply than a single mine. The Powell-Duffryn Co. had decided to put down at a central point among their Aberdare pits modern three-phase plant of about 4,500 H.P. to supply about 85 motors at their different pits. The discussion was then resumed on Mr. W. A. Scott's paper on "Electrical Motive Power for Collieries."

Electric Shocks.—At a meeting of the Tramways Committee of Dundee Town Council on 25th inst., a letter from a law agent was read on behalf of Mr. Edward Cumming, dairyman, Hawkhill, intimating that, while he was driving his horse and milk van along Overgate, the animal suddenly collapsed, throwing Mr. Cumming out, overturning the milk cans, and injuring the horse. He alleged that the shock was due to an escape of electric current from a defective main. The clerk, in view of the terms of a report by the engineer, had denied liability, and it was intimated that an action for £50 had been served upon the Council. The clerk was instructed to defend the action.

On Tuesday a cab-horse, passing along Wigmore Street, New Oxford Street, was killed by electric shock, due to leakage from electric light mains.

Royal Society.—The following papers were down to be read at yesterday's meeting:—"Further Experiments on the Production of Helium from Radium," by Sir Wm. Ramsay and F. Soddy. Dr. P. E. Shaw on "The Sparking Distance between Electrically-charged Surfaces," communicated by Prof. J. H. Poynting. Dr. S. Bidwell "On the Changes of Thermo-Electric Power produced by Magnetisation, and their Relation to Magnetic Strains."

Personal.—The Bolton Corporation tramway staff have presented a smoker's cabinet to Mr. G. Morris, car-shed foreman, on his removal to Leicester.

Our Wolverhampton correspondent says:—"Mr. Thomas Parker, J.P., has resigned his position as a director of Thomas Parker, Ltd., Wolverhampton, and Mr. James Underhill, solicitor, has been elected to succeed him. Mr. Parker is about to reside in London, where he is engaged as consulting electrical engineer to the Metropolitan Railway Co. Just recently Mr. Parker received from the Melbourne Government an offer of £5,000 to go out to Melbourne and advise on certain large and important electrical schemes, but owing to his business engagements he was obliged to decline the offer."

Preston Corporation Tramways Committee has appointed Mr. J. F. Simpson, of Blackpool, as assistant tramway engineer, at a commencing salary of £200 a year.

Lectures.—On Friday, April 22nd, before the Brighton Engineering Society, Mr. H. H. Broughton, vice-president, in the chair, Mr. J. J. Ellis, a former secretary of the society, read a paper on "Water-Tube Boilers."

Appointments Vacant.—Switchboard attendant for Eccles (24s); Junior electrician in charge (30s.) for Hornsey.

South African Notes.—From our Durban correspondent:—

Salisbury (*Rhodesia*).—The T.C. have under consideration an electric light scheme for the lighting of the town, but in view of the present depression of trade generally in South Africa, no steps will be taken to carry it out just yet. It is proposed to supply a continuous current at 100 to 220 volts at the consumers' terminals, for probably about 3,000 8-C.P. lamps at the start. The price per unit is given at 1s. 8d., and 108,000 units are estimated to be required for private lighting, and 54,000 units for public lighting. The plant capacity under consideration is 150 KW. with two water-tube boilers of 250 H.P., and two vertical condensing engines of 120 H.P. each. The total cost per unit sold is estimated at 1s. 1d., but these figures and plant are only approximate.

Germiston (*Transvaal*).—The General Electric Power Co., Ltd., at the "Rand Victoria," Germiston, are adding to their plant, which now consists of three 500-KW. sets, a 500-KW. set driven by a Curtis steam turbine, and four 300-H.P. Stirling boilers, and are just completing a new condensing plant with 6,000 sq. ft. of cooling surface and independent motor-driven centrifugal pumps for circulating, and two Edwards air pumps. It will be remembered that this company, besides supplying in bulk at 3,300 volts to the surrounding mines who transform down and distribute to suit themselves, also supplies the township of Germiston, which is, however, but a small part of the business, as the total amount of power generated in the station during 1903 was 4,576,524 units, of which only 253,932 units were accounted for in Germiston.

Pretoria (*Transvaal*).—At the annual meeting of the Pretoria Lighting Co. on March 30th, an 8 per cent. dividend was declared, and a large amount has been written off for old machinery, the present capacity being 800 KW. of "up-to-date" plant. A day supply is just being inaugurated for motors at from 4d. per unit, the present price for light being 11d. per unit.

Johannesburg (*Transvaal*).—At the annual meeting of the Tramway Co. on March 26th, it was reported that the work of the past year was extremely satisfactory. The total number of passengers carried was 4,152,026, and the number of miles run 483,158, whilst the average receipts amounted to a fraction over 5*s.* per mile. A profit of £27,682 10*s.* 9d. was made, and the total receipts of the year amounted to £93,113. The terms of the Town Council's proposal, that the company "shall sell all its assets, with the exception of the cash in hand and investments, to the Council for £150,000," will be submitted for acceptance at a special meeting on May 30th.

The Transvaal Technical Institute was opened on March 29th by the Lieut.-Governor of the Transvaal, Sir Arthur Lawley. A portion of the building was to be made use of for the museum of exhibits in connection with the Science Congress, which took place during the first week in April.

The T.C. on March 31st voted £9,140 for immediate extension of lighting plant. The chairman of the Lighting Committee states that the Council hopes, within six months, to give light to those citizens who have no light, and also to make a profit of £9,511 per annum.

Maritzburg.—Mr. P. Finlayson, late manager of the Port Elizabeth Tramway Co., has been appointed manager of the Maritzburg tramways now in course of construction.

Port Elizabeth. — Messrs. Jones & McWilliams, of Library Buildings, invite tenders until May 2nd for wiring for electric light at the Harbour Board new administrative offices, and the supply of all cut-outs, switches, switchboards, &c.

Cape Town.—Industries, of Durban, comments on the fact that Henley's South Africa Telegraph Works Co., Ltd., have secured a contract from the Cape Town Corporation "for the supply of electric light feeders and distributors for the very important extensions which are taking place in that city, and they have also received an order from the Table Bay Harbour Board for a large quantity of electric light cables, paper insulated, in connection with the illumination of the Cape Town Docks. This firm has further been entrusted with the supply of multiple-core underground telephone cables and other wires for the Government of the Cape Colony."

Natal.—Some correspondence is published in the *Natal Witness* on the subject of water-power and the advisability of more generally utilising the many waterfalls of the colony. *Apropos*, a correspondent (one "F. S.") says:—"Falls varying from 2 to 5 ft. may now be utilised successfully for electric installations. It is quite a mistake to suppose that nothing can be done unless waterfalls are available of considerable height. This mistaken idea has doubtless been accountable for some degree of backwardness in the adoption of electricity for private installations in the past. We have immense resources within a few miles of this very city (Maritzburg), but few, if any, appear to be aware of the fact." The writer concludes with the hope that sooner or later the "many hydraulic engineers . . . . will propound a scheme for the effective utilisation of the hitherto despised means at present available in Natal."

Cape Town.—A paper on "House Wiring" was lately read by Mr. E. G. Clifford Jones, M.I.E.E., before the members of the Cape Town section of the Institution of Electrical Engineers. Mr. Edwards, M.I.E.E., presided. At the close, and after some discussion, the following resolution was agreed to:—"That the Cape Town local section of the Institution of Electrical Engineers desires to draw the attention of fire insurance companies, architects and electricity consumers generally to the urgent need for raising the standard of electrical installations in South Africa. It is of the opinion that this result can be best attained in the following manner:—(*a*) By the employment in all cases of some properly qualified electrical engineer to draw up a specification in accordance with the rules of the Institution of Electrical Engineers, to supervise the carrying out of the work, and on its completion to furnish his signed certificate; (*b*) By periodical inspections (at least once every year) by some competent electrical engineer; (*c*) By requiring all wiremen employed upon electrical installations to be duly licensed by some competent body, such license only being granted after due examination, and being liable to withdrawal; (*d*) By the adoption by the fire insurance companies of a discriminatory tariff in favour of premises in which the electrical installations are thus satisfactorily inspected."

Congo Free State. — In "Some Congo Impressions," set down by Mr. A. Arkele-Hardwick, and published in the current issue of the *African World*, the writer thus describes a visit he paid to the local Marconi station at Banana:—"The instruments are set up in a little shed, with walls of palm stems; the dynamo, oil engine, and accumulators being housed in a more substantial building a few yards away. The operator was trying to get into communication with Ambrizette, a port in the Portuguese territory, two days' steam to the south, but had not yet succeeded at the time of my visit. It was explained that they hoped to get through in the coming wet season, as in the dry season there was not what electricians would call a "good earth."

THE CENTRAL STATION ENGINEER.

Mr. G. Sommerville was, on April 19th, appointed borough electrical engineer to the Faversham Town Council.

The Grays T.C. has increased the salary of its electrical engineer, Mr. E. D. Long, by £25 per annum.

Mr. W. A. Walker, late of Aldershot Electricity Works, has been appointed assistant electrical engineer at Kettering at a salary of £120 per annum.

At the York Corporation Electricity Works on 20th inst., Mr. A. J. Beckett, who has relinquished the post of chief assistant engineer in order to become "chief" at Bridlington, was presented with a smoking cabinet by the staff and workmen of the electricity department.

The E.L. Committee of Leicester T.C. has recommended the Council to increase the salary of Mr. Colson, electrical engineer, from £1,250 to £1,500 per annum.

A special meeting of the Chester T.C. was held on Tuesday for the purpose of appointing an electrical engineer for the city in the place of Mr. F. Thursfield, resigned. Out of 137 applications, the Lighting Committee had finally selected two applicants, who appeared before the Council, these being Mr. Sydney E. Britton, borough electrical engineer, Motherwell, and Mr. S. D. Scholfield, resident engineer, Shipley, Yorkshire. On the vote being taken, Mr. Britton secured the appointment by 22 to 15. The salary is £300 per annum, rising by annual increments of £50 to £500. Mr. A. Dimmack, chief assistant at Chester Electricity Works, was in the first list of candidates selected by the Chester Committee for interview in connection with the position of engineer-in-chief.

At a meeting of the Committee charged with the administration of the Dundee Electrical Department the other day, the proposed increase of the salary to Mr. Richardson, the engineer, was discussed. It was proposed that, in view of the likelihood of the engineer being appointed to a similar post under the Corporation of Chester, an addition of £100 should be given. Bailie Mechan and Mr. Speed, having regard to the present position of the finances of the Department, deprecated any such addition to the expenditure. In reply it was stated that, owing to the present transition stage of the works in connection with the relaying of the street mains, it would be false economy to run any risk of a change in the engineership. On a division, Bailie Mechan and Mr. Speed voted for the amendment, but it was resolved to transmit a unanimous recommendation to the Council to sanction the increase of salary.

The Lancaster T.C. on Wednesday discussed recommendations by the joint Electricity and Tramways Committees that the salary of the electrical and tramways engineer, Mr. W. A. Tester, be increased from £300 to £350; and that of the assistant engineer, Mr. D. A. Hamilton, from £156 to £175. Mr. Hamilton had received an increase 18 months ago, but Mr. Tester withheld his application, at the request of the chairman of the Committee until the new power station was in working order and the change in the voltage had been carried out. Eventually Mr. Tester's application was granted by 16 votes to 12, while that of Mr. Hamilton was refused by 15 votes to 8.

NEW COMPANIES REGISTERED.

Lodge Electric Light and Power Co., Ltd. (80,741).—This company was registered on April 2nd, with a capital of £3,000 in £1 shares, to acquire the business now carried on by H. Lodge, at 4, Whitworth Chambers, 8A, Lord Street, Liverpool, as the Lodge Electric Lighting Co., and to carry on the business of an electric light and power company in all its branches. The first subscribers are:—H. Lodge, 8A, Lord Street, Liverpool, electrical engineer, 5 shares; G. Johnson, 19, Grosvenor Drive, New Brighton, gentleman, 1 share; T. Bookless, 15, Portman Road, Liverpool, traveller, 1 share; J. L. Langford, 13, Union Court, Liverpool, estate agent, 5 shares; H. McCarthy, 13, North View, Edge Hill, Liverpool, book-keeper; T. Seddon, 22, Station Road, Prescot, clerk; and A. A. W. Jones, 41, North John Street, Liverpool, assistant, 1 share. Minimum cash subscription, 1 per cent. of the shares offered to the public. The number of directors is not to be less than two nor more than seven; the first are H. Lodge (managing director), and J. L. Langford; qualification, £5; remuneration as fixed by the company. Registered office, Central Buildings, 41, North John Street, Liverpool.

Electro-Peat Coal Co., Ltd. (80,714).—This company was registered on April 20th, with a capital of £130,000 in £1 shares, to carry on the business of peat-coal, peat-fuel, peat-charcoal, and fibrous peat, with or without the use of electric treatment, or minerals, or chemicals, paper and millboard manufacturers, contractors, merchants, carriers, shippers, importers, exporters, bankers, shipowners, miners, explorers, quarrymen, workers of and dealers in mineral substances, &c., and to adopt agreemepts (1) dated April 7th, 1904, between L. F. Kelly for this company, and C. Johnson, trading as "Johnson and Phillips," and (2) dated March 7th, 1904, between A. E. Whalley and L. F. Kelly (the latter for this company). The subscribers (with one share each) are:—L. F. Kelly, 4, Waldegrave Road, Upper Norwood, S.E., secretary; J. M. Scott, 9, Ackroyd Road, Brockley Rise, S.E., secretary; C. Cowley, 194, Putney Bridge Road, Putney, S.W., secretary; A. C. Turner, 221, Maida Vale, W., clerk; T. Dickins, 74, Barkworth Road, North Camberwell, S.E., clerk; H. A. Wicks, 216, Fernhead Road, Paddington, W., clerk; J. Kummey, 21, Lower Common, Putney, S.W., clerk. Minimum cash subscription, 10 per cent. of the shares offered to the public. The first directors are The Earl of Mayo, Palmerston, Co. Kildare; H. Allen, Timperley, Cheshire; J. Macgregor, Old Charlton, Kent; Col. T. A. St. Quintin, 69, Cornwall Gardens, W.; Sir L. Falkiner, Bt., Annemount, Cork; and R. Walker, Tidmarsh Grange, Reading.

New Century Lock and Engineering Co., Ltd. (80,698).—This company was registered on April 19th, with a capital of £500, in £1 shares (400 preference), to acquire the business now carried on at St. George's Works, George Street, Eden Grove, Holloway, and 235, High Holborn, W.C., and elsewhere, and to carry on the business of electrical, mechanical and automobile engineers, lock manufacturers, motor-car makers and repairers, gas, hot water, sanitary and ventilating engineers, &c. The first subscribers are:—H. Thorpe, 235, High Holborn, W.C., electrical engineer, with 267 preference and 48 ordinary shares; H. J. Salter, 235, High Holborn, W.C., electrical engineer, with 133 preference and 47 ordinary shares; J. L. Anderson, 1, Furnival Street, E.C., merchant, with one ordinary share; E. T. Clarke, 46, Dunlace Road, Lower Clapton, electrical engineer, with one ordinary share; Theresa Pettenati, 15, Caledonian Road, King's Cross, N., clerk, with one ordinary share; Mrs. J. Thorpe, 11, Bartholomew Villas, Kentish Town, N.W., with one ordinary share; and J. N. Maskelyne, Egyptian Hall, W., entertainment proprietor, with one ordinary share. No initial public issue. Table "A" mainly applies. Registered office, 235, High Holborn, W.C.

British Electric Separating Co., Ltd. (80,705).—This company was registered on April 20th, with a capital of £30,000 in £1 shares (4,000 deferred), to acquire the business of tin strippers now carried on at Swansea by the British Electric Separating Co., Ltd., to adopt agreements (1) with the said old company and R. P. Pike (the liquidator thereof), and (2) with H. A. Leaver, and to carry on the business of strippers of tin from tin-plate scrap and other articles coated with tin (by means of electricity or otherwise), electro-depositors of metals, &c. The first subscribers are:—H. A. Leaver, New Cut Road, Swansea, metal merchant, 100 ordinary shares; J. R. Leaver, J.P., Glannant, Westcross, Swansea, works manager, 100 ordinary shares; B. Dickinson, Briarwood, Worcester Park, Surrey, gentleman, 100 ordinary shares; C. E. Perry, Mayfield House, Wolverhampton, metal broker, 100 ordinary shares; W. H. Hyatt, 77, Woodstock Road, W., metallurgist, 1 ordinary share; T. E. Gray, Ethelburga House, E.C., coal factor, 1 ordinary share, and W. R. Renshaw, Fern House, Newcastle-on-Tyne, engineer, 100 ordinary shares. Minimum cash subscription, 20 per cent. of the shares offered to the public. The number of directors is not to be less than three nor more than six; the first are H. A. Leaver (managing director), J. R. Leaver, J.P., B. Dickinson, C. E. Perry, and W. R. Renshaw: qualification, £100: remuneration (except managing director) as fixed by the company. Registered office, New Cut Road, Swansea.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Northern Counties Electricity Supply Co., Ltd. (67,924).—Issue, on March 30th, of £10,000 5 per cent. mortgage debentures, part of series created February 18th, 1904, to secure £100,000. Property charged: The company's undertaking and property, present and future, except uncalled and unpaid capital. Holders: T. E. Hodgkinson and J. W. B. Pease, Collingwood Street, Newcastle-on-Tyne. No trustees. No previous issue of same series.

American Electrical Novelty and Manufacturing Co., Ltd. (71,891).—£10,000 debentures, created March 30th, 1904, have been registered. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Scottish House-to-House Electricity Co., Ltd. (29,232).—A mortgage or charge, dated March 31st, 1904, supplemental to a bond and disposition in security (in Scotch form), dated August 18th, 1903, to secure £75,718 1s. 4d., and 6 per cent. interest, has been registered. Property charged: The company's undertaking and property, including the Coatbridge and Airdrie undertakings, benefit of contracts, book debts, uncalled capital, &c. Holders: County of London and Brush Provincial Electric Lighting Co., Ltd.

Kent Electric Power Syndicate, Ltd. (72,742).—A mortgage or charge on the company's assets, present and future, including uncalled and unpaid capital (if any), created April 9th, 1904, to secure £1,000, has been registered. Holders: Hon. J. B. Lubbock and G. C. Curtis, both of 15, Lombard Street, E.C.

Wolverhampton District Electric Tramways, Ltd. (68,345).—A trust deed, dated April 11th, 1904, to secure £100,000 debenture stock (with power to issue further stock, ranking *pari passu* therewith, up to half the issued capital for the time being), has been registered. Property charged: The company's undertaking and property, present and future. Trustees: Electric and General Investment Co., Ltd., 1—2, Great Winchester Street, E.C.

ELECTRIC TRAMWAY ACCOUNTS.

Liverpool Corporation Tramways.

The tramways undertaking of the Corporation continues to progress in a way which is highly creditable to the management, and satisfactory to Liverpudlians generally. No special increase in route mileage is noticeable, and, perhaps, the most interesting feature of the year was the introduction of through running between the Pier Head and St. Helens *vid* Knotty Ash and Prescot, over the South Lancashire Tramway Co.'s system, in connection with which a substantial through traffic, especially in the summer, is noted. It may also be observed that the last of the horse cars was withdrawn in August, 1903, some 41,000 horse-car miles only having been run during the year.

Considering the numerous routes and excellent services provided in Liverpool, it is satisfactory to find a considerable average increase in income per car-mile, although this has been contributed to by a slight decrease in miles run.

As a result of the year's operations, a gross profit of £190,020 was earned, and after providing for financial charges, and reserve, renewals, and depreciation, the balance, a sum of £32,081, was contributed in aid of the general rate. Mr. C. R. Bellamy is the general manager.

For 12 months ending Dec. 31st	1903.	1902.
Length of route	53 miles	51 miles
Total length of track	103 miles	101 miles
Average number of cars in use	407	380
Car-miles run	11,724,097	11,790,815
Passengers carried per annum	113,015,728	109,335,585
Capital expended to date	£1,863,485	£1,832,977
Traffic receipts	£524,468	£506,728
Total "	£531,484	£517,935
Working expenses	£341,464	£339,811
Gross profit	£190,020	£178,124
Income per car-mile	10·73d.	10·34d.
Working expenses per car-mile	6·98d.	6·88d.
Interest, sinking fund & depreciation	2·19d.	2·08d.
Total expenses per car-mile	9·17d.	8·97d.
Profit or loss per car-mile	+ 1·56d.	+ 1·37d.
Cost of energy per car-mile	1·65d.	1·69d.
Average fare per passenger	1·11d.	1·11d.
Revenue per mile of route	£10,030	£10,155
Expenditure per mile of route	£6,443	£6,663
Total units used	17,978,718	16,855,113
Units used per car-mile	1·5	1·4
P'rcn'tage of working ex'es to receipts	64·25 %	65 %

Profit Statement for 1903.

To tramway and reconstruction sinking fund	£53,560
Interest on loans	53,454
Reserve, renewal, and depreciation fund	64,162
Contribution in aid of general rate	32,081
Sundry interest, &c., brought forward	− 13,226
Gross profit	£190,020

ELECTRICITY SUPPLY ACCOUNTS.

Liverpool Municipal Electricity Department.

The Liverpool Electricity Department, like its sister undertaking the tramways, continues to expand both in output and revenue. The maximum load has crept up to 12,600 kw., and the output to 26 million units. A satisfactory feature is the growing motor load, a class of business for which the area offers an excellent field. The working costs are an improvement on the previous year, and out of the gross profit of £107,000, a substantial balance remains after meeting financial obligations. The prices charged are: Private lighting, 3¾d. and 3d. per unit; power, 2d. and 1½d. per unit; traction, 1·05d. per unit. Mr. Alfred Clough is the city electrical engineer.

General Statement.

For year ending December 31st—	1903.	1902.
Total capital expended	£1,553,808	£1,336,709
Number of units sold—		
Private supply	8,697,474	7,039,350
Public lighting	274,837	256,154
Traction	17,042,751	15,890,579
Total number of units sold	26,015,062	23,186,083
Equivalent No. of 8-c.p. lamps connected	525,812	441,848
Number and h.p. of motors connected	1,111 = 4,234 b.h.p.	827 = 2,877 h.p.
Number of public lamps	189 arc 28 inc.	174 arc 56 inc.
Maximum load in kw.	12,600	10,539
Revenue account—		
Gross revenue	£206,311	£189,550
" expenditure	£98,775	£100,582
" profit	£107,536	£88,968
Average price obtained—		
Private lighting	3·3d.	3·45d.
Public lighting	2·0d.	2·00d.
Traction	1·1d.	1·20d.

Revenue Account.

	1903. Gross.	1903. Per unit.	1902. Per unit
Gross revenue	£206,311	1·90d.	1·96d.

Works Costs, &c.

Coal	£37,373	·34d.	·37d.
Oil, waste, water and engine room stores	6,776	·06d.	·06d.
Wages incurred in generation and distribution...	17,393	·16d.	·16d.
Repairs and maintenance of buildings, machinery and plant... ...	11,995	·11d.	·11d.
Works and distribution costs ...	£73,537	·67d.	·70d.
Rent, rates and taxes	12,743	·11d.	·09d.
Management expenses, salaries of engineer and clerical staff... ...	7,421	·07d.	·11d.
General establishment charges, insurance, law, printing and stationery	5,074	·05d.	·02d.
Total working costs	£98,775	·90d.	·92d.

Profit Statement for Year ending 1903.

Interest on loans	£43,577
Sinking fund	33,259
Balance on year's working	31,300
Provision for bad debts	63
Interest accumulated	— 663
Gross profit ...	£107,536

CITY NOTES.

Willans & Robinson, Ltd.

An extraordinary general meeting of this company was held on Wednesday at the Cannon Street Hotel, E.C. The chair was occupied by Mr. Mark Robinson.

The Chairman stated that the meeting had been called for the purpose of considering the appointment of, and if thought fit to appoint, Mr. George Wilson Anderson and Mr. James C. Peache, or either of them as directors of the company, and, if appointed, to settle the remuneration to be paid to them. Mr. J. F. Robinson, as chairman of the advisory committee, had recommended the appointment of those two gentlemen, and the feeling of the last meeting of the company seemed to the directors as a mandate for the election of those gentlemen.

Mr. A. W. Peabce asked if they could have the report of the advisory committee, and after some little discussion, the report was read by Mr. Robinson. The report spoke of the works at Queensferry, and stated that the committee were of opinion that orders for turbines had been taken somewhat too early, and that the same might also be said of the gas engine. The committee recommended that the steel works should be closed, and that the general staff of the works should be reduced.

A lengthy discussion ensued on the question of the management of the various works, at the end of which the Chairman moved the resolution for the appointment of Mr. Anderson at a salary of £250. Mr. Anderson, he said, would not have direct administrative functions.

Mr. J. F. Robinson seconded the motion.

A Shareholder asked if the two gentlemen would be in addition to the present board, or would they take the place of two of the present members?

The Chairman said that they would be in addition.

Another Shareholder asked what were the present sums paid to the directors?

The Chairman said that there were three senior directors, whose fees were fixed by the articles of association. He, as chairman, received £3,600 per annum, and his agreement provided that he should give the whole of his time to the affairs of the company, which should benefit by any invention of his. Sir Gilbert Clayton East received £710 per annum, and Capt. Sankey, whose agreement was the same as his own, received £2,290 per annum. Mr. A. Lazenby was at present in receipt of £1,000, which would be increased to £1,200 after September, 1905. The four managing directors were entitled by the articles of association to a percentage on surplus profits. There were no other directors' fees.

Col. Lloyd said that as one of the shareholders present at the former meeting, he was certainly under the impression that two of the old board would resign.

Mr. F. W. Clarke was of the same opinion.

Mr. Kitchen said that it was not desirable to increase the standing charges of the company. If the new directors were elected he thought that the present board should find their remuneration; £8,550 was a large sum to pay for the management of a company however prosperous. There present position was due to extravagance, and those who were responsible should pay. He moved an amendment to the effect that the remuneration should be paid by the board.

This was seconded by Mr. Balfour.

Mr. Holland thought that this was not the time for them to reduce the salaries of the board. If they left the business in the hands of the chairman he believed he would pull them through.

The amendment was carried by a large majority.

The Chairman said that as the amendment had been carried, he should demand a poll of the whole of the shareholders.

Ultimately, after a further lengthy discussion, an amendment to the amendment, which the proposer and seconder accepted, to the effect that the foregoing amendment was only an expression of the opinion of that meeting, and was not in any way binding on the board, was carried.

Mr. J. C. Peache was then appointed a director. On the question of his salary, which was to be at the rate of £2,000 per annum, a poll was demanded. The poll will take place at Cannon Street Hotel in a fortnight's time.

Cuba Submarine Telegraph Co.

The directors' report for the half-year ended December 31st, 1903, says that the total receipts of the six months were £18,644, while the expenses amounted to £5,810, leaving a balance of £12,834, to which has to be added £6,137 brought forward from last account, giving a total of £18,971 to be dealt with.

£5,000 has been added to the reserve fund, which now stands at £155,000. The dividend on the preference shares will absorb £3,000, and leave £10,971, out of which the directors recommend the payment of a dividend at the rate of 5 per cent. per annum on the ordinary shares, free of income-tax; the balance, £5,971 being carried forward to the current half-year. The Cienfuegos-Santiago 1875 cable became interrupted on December 21st. The Mexican Telegraph Co.'s steamer *Mexican* was hired for its repair, but the directors regret to report that the operations were unsuccessful. In view of the above the directors have entered into a contract with Hooper's Telegraph and India-Rubber Works, Ltd., for a new cable to be laid between the same points. The applications to the United States Government for payment of the claim for the cost of repairing the damage done to the cables during the Spanish-American war, and to the Cuban Government for payment of the subsidy for the coast cables, are still under consideration.

Oriental Telephone and Electric Co., Ltd.

The meeting of this company was held on Wednesday, at the Great Eastern Hotel, under the chairmanship of Sir Auckland Colvin, K.C.S.I.

In moving the adoption of the report, the Chairman said the year under review again showed a steady progress at all the branches, as well as the subsidiary companies. This progress was most noticeable in Rangoon and Singapore, and especially in Egypt, where larger receipts might be expected this year, when fresh installations, which had been in hand for some time, would be completed. Their operations in Egypt were of three kinds: (1) The exchanges in Cairo and Alexandria and other minor towns; (2) The trunk line between Cairo and Alexandria, which had been erected and was maintained by the Egyptian Government, and leased provisionally to the company for a term of two years expiring on April 30th, 1905, when the terms of the lease were open for re-consideration; and (3) What were known as provincial lines. These lines connected the centres of the Government's administration in the provinces with various sub-centres indicated by the Government. These were erected by the company, and leased annually to the Egyptian Government for a term of 28 years. These lines, as at present approved by the Egyptian Government, covered 3,500 miles, and he understood that they were about to receive a further order for a considerable fresh extension. In Hong Kong also business was extending rapidly, and in that city cable construction, partly underground, would have to be carried out. In the seven cities of Calcutta, Bombay, Madras, Rangoon, Moulmein, Singapore and Hong Kong, metallic circuiting by underground cables must be carried out within the next four years, and considerable expense would have to be provided for later on to carry this out. Bombay would, it was understood, meet its own expenditure, but a considerable portion of the Calcutta expenditure, and the whole of the expenditure in the other towns mentioned, must be met by funds provided by the Oriental Telephone Co. They held £12,000 of Consols which would be available in connection with capital expenditure within the next few years. The Straits Government had conceded a new lease of their license for a term of 31 years. The Cairo and Alexandria exchanges had been very greatly strengthened by the completion of the underground circuiting, which they had carried out in accordance with the agreement arrived at with the Egyptian Goverment in 1898. The trunk line between Cairo and Alexandria had met a great want, and became more and more popular, and other similar exchanges were working satisfactorily. Fresh exchanges, it was believed, would shortly be opened in other towns, and in the growth of the provincial lines they had an assured and constant source of increase in their revenue. In view of the capital expenditure which had already taken place, and which lay before them in consequence of the rapidly growing extension of their business, the board had in principle approved of the establishment of a capital redemption fund, but they were not at the moment able to come to a definite decision as to the detailed application of the scheme, because certain negotiations were now proceeding with the Egyptian Government, by which the Egyptian company hoped to be enabled to provide for the ultimate redemption of its own capital, which was held practically wholly by the company. This would, of course, reduce the provision they would have to make for the redemption of the Oriental Co.'s capital, and the remaining subsidiary companies. It was to be noticed that the scheme of metallic circuiting in India and Singapore would, in accordance with the conditions imposed in the new licence, be carried out by underground cables only so far as the Governments of India and Singapore might desire the adoption of that system. That year the board had recommended a slightly higher dividend, and they looked forward to the steady growth of the business. They must be prepared to be called upon from time to time to raise capital for extensions, but in view of their sound condition, he thought it could be obtained without undue difficulty.

Mr. T. Lloyd seconded the motion, which was carried after some discussion regarding the fees which the directors received from the company and the various subsidiary companies.

Urban Electric Supply Co.

The annual general meeting of the shareholders of this company was held on 21st inst. at the offices, Broad Sanctuary Chambers, Westminster, Mr. J. C. Wigham presiding.

The Chairman, in proposing the adoption of the report, said that during the year they had been able to complete and open their works at Grantham, Berwick, Newton Abbot, Caterham and Glossop, including the tramways in the last-named town, and they expected to open their works at Newbury in a few weeks. They would then have the whole of their works running. The number of lamp connections had risen during the year from 48,000 to 140,000, and since the end of the year they had connected a further 15,000. The progress made had exceeded their expectations, and reflected great credit upon the management and energy of their resident engineers who had charge of the various towns. The working results of the year had been very satisfactory. Although only seven of the undertakings had been working for the full year, the net profits amounted to £12,181. He predicted last year that they would earn sufficient to pay the dividend on their preference shares, which required £7,500, without having to call upon the guarantors, and they had done so much better that they had only had to call upon them for £3,887 towards the £8,500 required for the guaranteed dividend on the ordinary shares. The dividends on both the preference and ordinary shares had been duly paid on the dates fixed. To provide the additional capital required for the works which had been carried out, the directors at the end of last year issued 16,000 ordinary shares, and now proposed to make an issue of £200,000 4½ per cent. debenture stock, which would be offered for subscription within the next few days, and they anticipated that the increased earnings of the present year would be sufficient to meet all the charges on this additional issue of shares and debentures. The rapid development of the business naturally involved, to some extent, a corresponding increase in the rate of their capital expenditure to meet the larger demands made by their customers. With regard to the question of depreciation, no provision had yet been commenced. During the first three or four years in such undertakings as theirs no provision for depreciation could be expected. The works and machinery were quite new, and were maintained in perfect order and repair out of revenue. Under the terms upon which the various local authorities could purchase their undertakings, no depreciation could be deducted by them for many years to come, but in good time the directors would begin to make provision on that account.

Mr. W. Page seconded the motion, and the report was adopted.

Eastern Extension, Australasia and China Telegraph Co.

The report for the half-year ended December 31st, 1903, to be submitted to the meeting on 4th prox., states that gross receipts have amounted to £265,260 against £267,553 for the corresponding half-year of 1902. Working expenses, including £33,400 for maintenance of cables, absorb £142,419, against £121,869 for 1902, leaving a balance of £122,840. From this is deducted £4,473 for income-tax, £12,513 for interest on debenture stock, &c., leaving net profit for the half-year £105,854. After adding £71,036 brought forward from the previous half-year, there is an available balance of £176,891. One quarterly interim dividend of 1½ per cent. has been paid for the half-year, and it is now proposed to distribute another of like amount, making, with the interim dividends paid for the first half-year, a total of 5 per cent. It is also proposed to pay a bonus of 4s. per share, or 2 per cent., making a total distribution of 7 per cent. for the year. The balance of £41,891 has been carried forward. Further cable renewals have been carried out during the half-year under review, and the cost, amounting to £10,855, has been charged against the reserve fund.

River Plate Electricity Co.

Mr. M. W. Mattinson, K.C., presided at the meeting held in London last week, he stated that the net revenue upon the running of the business in Argentina was £13,565, that representing a full year's work at the La Plata and Tucuman stations, and three months at the Buenos Ayres station. The Buenos Ayres station was purchased by the German company in the early part of the year, and the company was only entitled to the profits for the three months ended March 31st. The company had raised a substantial sum by means of debentures, with a view to putting the various stations into good condition, but it had not been possible to advantageously spend that money up to the present. Depreciation had been allowed on machinery, amounting to £801. The directors had proceeded upon the definite plan of charging 2½ per cent. for depreciation upon the book values of the machinery. The amount charged in future would be more, as the book values of the machinery would grow. The company was getting pretty well out of the mess in which the old company had been involved. The temporary loans lent by the company amounted to £72,450. As to the prospects of the company in Tucuman, there was the question as to whether the company should continue to do the public lighting, as the municipality had asked for very great concessions. The directors had under consideration the purchase of two small stations. The negotiations had gone on, but the sellers had been unable to give the company the titles to the stations, and the contract had been rescinded.

Indo-European Telegraph Co.

Mr. C. Holland (chairman) presided at Winchester House, Old Broad Street, E.C., on Wednesday, at the thirty-seventh ordinary meeting of the above company.

In moving the adoption of the report, the Chairman said the International Telegraph Conference was opened by the then Postmaster-General, Mr. Austen Chamberlain, on May 26th, 1903, and the directors had the pleasure of meeting the many distinguished representatives of foreign Governments with whom the company has been in constant communication for so many years. The alterations in the regulations annexed to the Convention did not materially touch the company's interests, but certain reductions in the tariffs would affect the company's receipts to some extent. Such reductions were, at International Conferences, settled primarily by the Governments concerned, and although the representations of the companies were always accorded a ready hearing, tariff alterations had to be looked upon from an international standpoint. However, he did not think the company's revenue would be seriously affected. There was a falling off in their receipts for the year 1902, amounting to £18,735, brought about by the reduction in the rate to India. They had decreased this loss in 1903 by £4,789, owing to an increase in the traffic exchanged with South Russia and India. The increase in the Indian traffic was satisfactory, but he did not altogether hold the view that the lowering of the rate had brought about this increase, which should be attributed partly to the improved trade of the country. The terms of an agreement had now been arranged with the Postmaster-General and the Imperial German Post Office for the leasing of land wires in this country, and submarine cable wires between this country and the German coast, and they expected to have the detailed agreement very shortly. The lines of the company had worked well during the year, and the direct Wheatstone working, which had proved so successful between London and Teheran, had now been extended to Manchester and Liverpool. The amount of £12,394 was released under the arbitration award, and must be looked upon as a windfall; it had accrued during the years 1901 and 1902, and did not belong to this year's revenue. The directors hoped, therefore, that the shareholders would take the view that this was, literally speaking, a golden opportunity for placing the officers' retirement scheme upon a sound basis, and would adopt the recommendation of the directors, and appropriate this sum for the trust now proposed to be created. Last year the scheme was approved in principle by the shareholders, who voted £5,000 towards its formation. Since that time it had taken definite shape, and had been in operation since October 1st, 1903. The main principle underlying the scheme was that on reaching the age of 55, coupled with 25 years' service in the company, a member of the staff became eligible for retirement upon half-pay. This half-pay would be continued during his lifetime, so long as the company carried on business. Upon liquidation of the company it would become necessary to make provision for the continuance of his half-pay by the purchase for him of an annuity. It was to the purpose of purchasing such annuities that the directors wished to apply sums voted by the shareholders, and they had decided that the only satisfactory way to attain the desired result was to form a trust fund outside the company's assets, and to hand over to this trust fund the sums already voted or to be voted. With regard to the financial aspect of the report, there was an increase of £4,789 in the revenue, and he had already explained how this increase had been brought about. The increase in expenditure amounted to £4,541, and was accounted for mainly by an increase this year of maintenance charges (which last year were under the average), and by the cost of a considerable purchase of telegraph poles for stock. The dividend absorbed £14,875, and to this amount was added the bonus, £17,000, making a total of £31,575. The directors proposed to add £15,000 to the equalisation of dividends fund, to apply an additional sum of £10,000 to the depreciation of reserve fund securities—necessitated by further shrinkage of values, and to carry forward £16,365 to the credit of 1904 after payment of the dividend and bonus. With regard to the outlook for 1904, the further reductions in tariffs agreed to at the International Telegraph Conference, which come into force on July 1st next, were likely to cause a decrease in the revenue, but he did not anticipate that the accounts for 1904 would show any serious diminution of receipts. At the close of the present year, 1904, their whole undertaking, so far as the Russian section was concerned, passed to the Russian Government under the concession, and became absolutely their property. In the balance sheet this section stood in the books at the sum of £313,285 5s. 5d. It would consequently be necessary to write off this item altogether. This would be done by charging it to reserve fund. The only item then remaining to represent the original cost of construction would be £25,244, book value of the Persian section. The issued capital of the company, £425,000, would then be represented by over £570,000 of first class investments, for they had invested an additional £25,000 since January 1st, 1904. The board of directors might, he thought, congratulate the shareholders and themselves that the policy they had adopted had been one of long continued and rigorous application of the sinking fund principle, and he might be pardoned, perhaps, if he added, comparing great things with small, that its rigorous application in national finance was of the highest importance to the State. The equalisation of dividends fund would now stand at £30,000, and in view of the many adverse possibilities inseparably connected with an undertaking such as theirs, might perhaps require further strengthening.

Mr. W. S. Andrews seconded the motion, which was carried without discussion.

Subsequently an extraordinary meeting was held, when it was agreed to alter the articles of association in several particulars, so as to enable the company to form a trust for the officers' pension scheme.

Leamington and Warwick Electrical Co.

The report for 1903 states that gross receipts for the year amount to £6,739. After deducting all expenses chargeable to revenue, including repairs and maintenance, and interest on debentures, there remains a profit of £1,810. To this has been added £68 brought forward, and after deducting the interim dividend of 2 per cent. paid in November last, there remains an available balance of £1,561. The directors recommend that there should be placed to depreciation and reserve fund £700, and, after paying a dividend at the rate of 5 per cent. on the ordinary shares (making, with the interim dividend paid in November last, a total distribution of 7 per cent. for the year), there remains to be carried forward £68. Capital expenditure during the past year in connection with the reconstruction of the lines and equipment for the supply of electricity amounted to £9,860. Of this amount £7,243 was incurred in the purchase of generating plant and machinery, £2,076 in laying mains for the supply of electrical energy, and £420 for legal expenses, &c., in connection with the promotion of the Warwick Electric Lighting Order, 1901.

Prospectuses.

The Urban Electric Supply Co.—This company is before the public until Monday next, with an issue of £200,000 4½ per cent. first mortgage debentures, which are offered at 98. The company, our readers are aware, is busily engaged upon electric supply in a number of places in the provinces, and is doing a progressive business. The company had spent upon its undertakings at December, 1903, £586,394; its profits last year were £12,181, and this year they are expected to be £21,000 or more. The proceeds of the present issue will be paid to the contractors, Edmundson's Electricity Corporation, Ltd., for works which have been constructed or are in progress. The stock is redeemable at 105.

The Electro-Peat Coal Co.—This week the prospectus of this company has been widely advertised, and the list was to close yesterday. We gave our own view of the concern on page 687 of our last issue.

Gravesend and Northfleet Electric Tramways Co.

The report for 1903 states that total revenue from the year's working amounted to £12,977. After deducting all expenses chargeable to revenue (including £1,130 for debenture interest), there is a profit of £3,305. Adding to this £938 brought forward, and deducting the dividend paid on the preference shares on October 1st last, there is an available balance of £3,315. The directors recommend that there should be placed to reserve and renewals fund £1,000. A dividend of 3 per cent. is recommended on the ordinary shares subscribed at January 1st, 1903, and on the remainder as from the dates of the various instalments, leaving to be carried forward £727.

Stock Exchange Notices.—The Committee has appointed special settling days as under:—Thursday, May 5th. National Telephone Co., Ltd.—Provisional certificates (fully and partly paid) of a further issue of £1,000,000 4 per cent. debenture stock. The Committee has also ordered the under-mentioned securities to be quoted in the Official List:—Hadfield's Steel Foundry Co., Ltd.—250,000 ordinary shares of £1 each, fully paid, Nos. 1 to 250,000; and 20,000 4½ per cent. cumulative preference shares of £10 each, fully paid, Nos. 1 to 20,000. National Telephone Co Ltd.—Provisional certificates (partly paid) of a further issue of £1,000,000 4 per cent. debenture stock, and a further issue of £89,593 4 per cent. debenture stock. Underground Electric Railways Co. of London, Ltd.—£3,599,268 5 per cent. profit-sharing secured notes (fully-paid provisional certificates).

West Coast of America Telegraph Co.—The report for 1903, to be presented at the meeting on the 3rd prox., states that the gross receipts have amounted to £35,707, an increase of £1,414, and the working expenses to £28,381, an increase of £4,086, largely due to the cost of repairing cables. After providing £6,000 for interest on the 4 per cent. debentures and £800 for interest on the 4 per cent. income bonds, there remains £526, to which is added £571 brought forward from 1902, making £1,097 to be carried forward.

Submarine Cables Trust.—The report for the year ended April 15th last, states that the revenue for the year amounted to £24,583, and expenses to £1,170, leaving a balance of £23,413, to which is added the sum of £118 brought forward from the last account, making an available balance of £23,531. After providing £19,314 to meet payment of the coupons, £4,156 has been transferred to the redemption fund, leaving a balance of £61 to be carried forward.

Brush Electrical Engineering Co., Ltd.—The directors recommend, subject to audit, payment of the full 6 per cent. dividend on the preference shares for the year ended December 31st, 1903, placing £7,000 to general reserve, £6,500 to depreciation reserve, and carrying forward £3,057 11s. 5d. The transfer books will be closed from April 28th to May 10th, 1904, inclusive.

South London Electric Supply Corporation.—This Corporation reports having sold during the quarter ended Lady Day 2,120,539 units, realising £18,600; the figures for the corresponding quarter in 1903 were 1,376,227 units, realising £7,305.

STOCKS AND SHARES.

Wednesday Evening.

Another sharp spurt in business came welcomely to reassure the Stock Exchange that a few slack days did not necessarily mean the return to idleness. A 3 per cent. Bank Rate makes a capital basis for Stock Exchange business to work upon, because people with money are already showing their unwillingness to leave that money with the banks upon deposit at 1½ per cent. Hence a goodly amount of new capital is flowing to the markets, and the result may be seen in the healthier prices in almost every department.

Electrical sections, however, still rather lag behind in the general rising tendency. The Telegraph list again shows a fair sprinkling of advances, but the improvements are not so many as those of last week. Electrical Supply issues, on the other hand, remain quiet, although a reflection of the rise in other markets is to be seen in several advances among the first-class shares. Railway and Traction securities are all but motionless.

Amongst Supply shares, Urbans continue a trifle dull upon the appearance of the Debenture issue which we were able to announce last week. The 4½ per cent. at 98 corresponds with our information, and the amount is £200,000. Well-secured and cheap, there can be little doubt as to the success of the issue, and in time the stock will probably climb to something like the same level as Edmundson's 4½ per cent. Debenture, viz., 105½. County Second Debenture has risen a point to 101½, but the principal change is in Blackheath and Greenwich 4½ per cent. Debenture, which is up 3 to 117½. This is due, of course, to the re-arrangements proposed, and as the stock is very tightly held the demand created by publication of the terms had a sharp effect. Even now it is very difficult to buy the stock at the quoted price. Blackheath Preference has fallen ⅛ to 1⅛, at which the shares look cheap enough to buy. Kensington Ordinary are ½ better at 12, and the Debenture has regained a point, and quiet buying of Metropolitans put the price up 20s. to 19½. At 11 Bromptons are ¼ to the good, and a similar advance makes South Londons 3½, the heavy showing made by the returns for last quarter affecting the price. Brush Preference have been in request on the report; the price has gained 10s., and is back at 1¼, the other issues of the company being unaltered. Charing Cross Ordinary, Westminster Preference, and Chelseas are all 5s. better.

Nothing sensational marks the Telegraph list as pre-eminent this week. Commercial Cable certificates have been bought from New York, and are 5 up, being now 185. Anglo-American Ordinary and Preferred have shared in this movement, both rising 1 per cent. to 50½ and 94 respectively, although Direct United States have contradictorily slipped back ¼ to 10¼. Of the Eastern group, "China" shares are strongest, a 5s. rise making them 12. Eastern Telegraph Ordinary has only risen 1 to 124½, at which price it is still relatively higher than the Extension shares. Globe Ordinary put on 5s. again in consequence of the rise in this market, and are 9. At 12½ the Preference yield just under 5 per cent., and appear to be a sound investment. West India 5 per cent. Debentures, at 10½, have added a point.

"The time for a relapse in National Telephone Deferred must surely be somewhere near at hand." This last week's prophetic venture is followed by a decline of 2 in the price of the stock, but with the temper of the public still keen upon Industrials, a further recission may for the time be stayed. Hereafter it will come. Beyond this, the National issues are all steady. A Special Settlement in the new Debenture stock takes place on May 5th—the end of next week, and the price is still about 3⅝ premium.

After new Urban and new Telephone Debenture, it is difficult to praise the new Electro-Peat Fuel Co. Possibly there is financial success waiting for its exploitation, but we greatly doubt whether the present company, or any other, will make the business pay on its present lines of misapplied electrical energy, and there are strong possibilities of the quotation of the shares going to a discount after allotment. The shares certainly do not appear to be worth their par price.

Metropolitan Consolidated has stiffened to 91½, and Districts are 35. None of the Electrical Railway stocks have moved. Great Northern and City Preferred "A" shares keep about 6. British Electric Tractions of both sorts are ¼ down. The Royal visit to Ireland has not advanced Dublin United Trams, which are 13 and 15½ for Ordinary and Preference. London United Preference at 11½, and the Debenture at 102, seem to stick at those prices. Anglo-Argentine Tramways Preference have been done over 5, and Buenos Ayres and Belgrano Ordinary are 2⅞ middle. British Columbia Railway Preferred Ordinary hardened a trifle to 100½, the Deferred being about par. Calcutta Trams mark 7.

In the Miscellaneous section, the British Insulated trio has receded ¼ in the case of the Ordinary and Preference, and 1 in the Debenture stock, the three prices being 5⅞, 5½, and 103½. British Aluminium "A" Preference are 8½, and General Electric Preference put on ¼ at 9½. No change from our last week's prices has occurred either in Babcock & Wilcox or Willans & Robinson, while Westinghouse Preference at 4 are a shade firmer.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations April 20th.	Closing Quotations April 27th.	Business done week ended April 27th, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2½ — 3½	2½ — 3½	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	.. — ..	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	6½s.	6d/6	6½s.	48 — 51 xd	49 — 52	..	..
8,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	92 — 94 xd	93 — 95	94⅜	93
8,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	7⅜ — 7⅝	7⅜ — 7⅝	7 7/16	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	..	4½ — 5½	4½ — 5½	..	..
18,333,300$	Commercial Cable	$100	8 %	8 %	..	175 —185 xd	180 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	91 — 93	91 — 93	..	..
16,000	Cuba Telegraph	10	4 %	6½%	5 %	7⅛ — 8⅛	7⅛ — 8⅛	..	..
6,000	Do. 10 % Pref.	10	..	..	..	15⅛ — 16⅛	15⅛ — 16⅛	..	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	..	2⅜ — 3⅛	2⅜ — 3⅛	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	99 —102	99 —102	..	..
60,710£	Direct United States Cable	20	3½%	3½%	..	10½ — 10¾	10¾ — 11	10¾	10½
85,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	121 —126 xd	122 —127	126	123
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	85 — 88 xd	85 — 88	..	..
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	104 —107	104 —107	107	105½
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	11¾ — 12	11¾ — 12⅛	12⅛	12
820,000£	Do. 4 % Deb. Stock	Stock	..	..	..	103 —106	103 —106	104½	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	101 —104	101 —104	..	..
180,227	Globe Telegraph and Trust	10	5½%	..	..	8⅝ — 9	8⅞ — 9⅛	9⅛	8⅞
180,042	Do. do. 6 % Pref.	10	..	..	..	12⅛ — 12⅜	12⅛ — 12⅜	12⅜	12⅜
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	27 — 28	27 — 28	..	..
58,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —101	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	42 — 45	42 — 45	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	100 —103	100 —103	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	6 %	6 %	103 —105	103 —105	104	103⅛
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	91 — 93	88 — 91	90⅞	86½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	10 — 12	10 — 12	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	10 — 12	10 — 12	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	5⅛	5 1/16
600,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 — 99	97 — 99	..	..
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101 —103	101 —103	102⅜	..
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6½%	⅛ — 1 1/16	⅛ — 1 1/16	1	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1 — 1⅛	1 — 1⅛	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	..	..	6½ — 7⅞	6⅞ — 7⅞	..	..
8,808	Submarine Cables Trust	Cert.	..	..	..	117 —122 xd	117 —122	120	..
58,000	United River Plate Telephone	5	7 %	7 %	..	5½ — 6	5½ — 6	5 1/16	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4½ — 5½	4½ — 5½	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	102 —105	102 —105	..	..
15,609	West African Telegraph, Shares	10	..	2 %	..	5 — 6	5 — 6	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	97 —100	97 — 100	..	..
287,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	..	12¼ — 12¾	12¼ — 12⅞	12⅝	12⅜
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —104	101 —104	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	99 —102	99 —102	..	..
88,821	West India and Panama Telegraph	10	..	..	..	⅜ — ½	⅜ — ½	½	⅜
84,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	5⅞ — 6⅛	5⅞ — 6⅛	6⅛	5⅞
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	4½ — 5½	4½ — 5½	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	..	..	..	99 —102	100 —103	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	4¼ — 5½	4¼ — 5½	..	..
800,000£	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	90 — 95	90 — 95	..	..
100,000	British Electric Traction	10	9 %	8 %	..	8¾ — 9¼	8¾ — 9	9 1/16	8⅞
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	10 — 10¼	9¾ — 10⅛	10 3/16	9 13/16
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	114 —117	116 —119	..	..
100,000	British Insulated and Helsby Cables	5	10 %	10 %	8 %	5⅜ — 6⅛	5¼ — 5⅜	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	c 5⅛ — 5⅜	5⅛ — 5⅜	..	..
60,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —107	101 —106	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	9/16 — 11/16	9/16 — 11/16	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	Nil	1/4 — 3/4	1/4 — 3/4	3/4	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	6 %	¾ — 1	1 — 1⅛	1 1/16	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	96 — 99	96 — 99	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	72 — 77	72 — 77	73⅞	..
85,000	Callender's Cable Construction shares	5	20 %	15 %	..	10¼ — 11¼	10¼ — 11¼	10⅜	10¼
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5¼ — 5½	5¼ — 5½	5¼	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	104 —108	104 —108	104	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	92 — 95	92 — 95	95	93
494,093	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	98 —101	98 —101	..	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	85 — 88	85 — 88	..	..
1,330,000	City and South London Railway	Stock	2 %	3½%	2⅔%	49 — 52	49 — 52	51	49
85,000	Crompton & Co., Nos. 1 to 85,000	8	7½%	5 %	..	1⅞ — 2⅛	1⅞ — 2⅛	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	96 — 99	96 — 99	98½	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	0 — 1/4	0 — 1/4	..	..
17,139	Do. do. "A" shares, 01—017,139	5	Nil	Nil	..	¼ — 1½	¼ — 1½	..	..
44,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	72 — 77	72 — 77	..	..
100,000£	Do. do. 5% 2n Deb. Stock Prov. Certs. all pd.	100	..	..	..	74 — 79	74 — 79	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	..	1½ — 1¾	1½ — 1¾	1 1/16	1 1/16
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2¾ — 3	2¾ — 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9 — 9½	9⅛ — 9⅜	9⅜	9 1/16
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	98 — 98	98 — 98	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	11½ — 12½	11½ — 12⅝	..	..
200,000	Do. do. 4½ % Pref.	5	..	..	..	5 — 5½	5 — 5½	5 1/16	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111	107 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18½ — 19½	18½ — 19½	19⅛	18⅜
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	99 —102	99 —102	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	4 3/16 — 4 5/16	4 3/16 — 4 5/16	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10½	..	..
37,350	Telegraph Construction and Maintenance.	12	20 %	20 %	20 %	34 — 37	34 — 37	37	35
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3⅛%	3⅛%	89 — 92	89 — 92	90	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (April 21st, 1904).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years			Closing Quotations April 20th.	Closing Quotations April 27th.	Business done week ended April 27, 1904.	
		‡	1901.	1902.	1903.			Highest.	Lowest
100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	1	..	..	..	⅝ — ¾	⅝ — ¾	..	..
50,000	Do. 7 % Pref.	1	..	..	..	1¼ — 1⅜	1 — 1¼	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	..	..	..	113 —116	115 —120	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000	5	8 %	8 %	10 %	10½ — 11	10½ — 11¼	11	10⅝
20,000	Do. do. 7 % Cum. Pref.	5	..	..	..	10¼ — 10½	10¼ — 10½	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	106 —109	106 —109	..	..
50,000	Charing Cross and Strand Electricity Supply	5	10 %	10 %	8 %	7 — 7¼	7¼ — 7⅜	7⅜	..
70,000	Do. do. do. 4½% Cum. Pref.	5	..	..	..	5⅛ — 5¼	5⅛ — 5¼	5 3/16	5 3/32
40,000	Do. do. "City Undertaking" 4½% Cum. Pref.	5	..	..	..	4½ — 5	4½ — 5	..	..
40,000	Do. 1903	5	..	..	..	4½ — 5	4½ — 5	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	102 —104	102 —104	103⅜	103
44,486	*Chelsea Electricity Supply, Ord.	5	4 %	4½%	5⅛%	6 — 6½	6½ — 6⅝	..	..
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	106 —109	106 —109	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	5 %	5 %	5 %	10½ — 10¾	10½ — 10¾	10 5/16	10 7/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	..	..	..	13 — 14	13 — 14	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	131 —136	131 —136	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	101 —104	101 —104	103⅜	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4 %	7 — 8	7 — 8	7 1/16	7½
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	..	..	..	11 — 12	11 — 12	..	..
400,000‡	Do. do. 4½% Deb. Stock	..	..	..	..	106 —109	106 —109	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	99 —102	100 —103	100½	100
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	5⅞ — 6¼	5⅞ — 6¼	5⅞	..
30,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6¼ — 6½	6¼ — 6	5¾	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock	100	..	..	..	104 —107	104 —107	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	12½	11 — 12	11½ — 12½	..	..
90,000	Do. do. do. 4 % Debenture Stock	Stock	..	..	..	101 —104	102 —105	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1 — 1⅛	1 — 1⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	4¼ — 5	5 — 5	..	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	94 — 97	95 — 98	96¼	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6¾%	7¼%	8¼%	18 — 19	19 — 20	19½	18¾
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid	5	..	..	..	5⅛ — 5⅜	5⅛ — 5⅜	5¼	..
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	109 —113	109 —113	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	95 — 98	95 — 98	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	6 %	12½ — 13½ xd	12½ — 13½	..	..
50,000	Do. do. 4 % First Mort. Debs.	100	..	..	..	99 —102	99 —102	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14 — 15	14 — 15	14⅞	..
20,000	Do. do. do. 7 % Pref. 20,001 to 40,000	5	..	..	..	8 — 9	8 — 9	8⅝	..
150,000‡	Do. do. do. 3½% Deb. Stock Red	100	..	..	..	97 —100	97 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	2½%	4 %	3 — 3½	3 — 3½	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	85 — 90	85 — 90	..	..
65,000	South London Electricity Supply, Ord.	5	..	1¾%	3 %	3 — 3½	3½ — 3⅝	3⅝	3 7/16
30,000	Urban Electric Supply, Ord.	5	..	..	..	4⅜ — 4½	4⅜ — 4½	4 3/32	..
30,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4½ — 5	4½ — 5	..	..
110,000	Westminster Electric Supply, Ord.	5	10½%	12 %	13½%	12½ — 13½	12½ — 13½	13	12 11/16
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6½	6½ — 6½	6 1/16	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, April 27th.

CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£18	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£21 10	..
a Lead, Nitrate	per ton	£24	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks	per lb.	8d.	..
a ,, Caustic (75/80%)	per ton	£24	..
a ,, Bisulphate	per ton	£35	..
a Shellac	per cwt.	225/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 10	..
a Recovered	per ton	£5 10	..
a ,, Lump	per ton	£6	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a Crystals	per ton	£3	..
a Bichromate, casks	per lb.	2½d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£180	..
b ,, Wire, in ton lots	per ton	£168	..
b ,, Sheet, in ton lots	per ton	£166	..
p Babbitt's metal ingots	per ton	£43 to £130	..
c Brass (rolled metal 2" to 12") basis	per lb.	6½d.	..
c ,, Tube (brazed)	per lb.	8⅞d.	..
c ,, ,, (solid drawn)	per lb.	7¾d.	..
c ,, Wire, basis	per lb.	7d.	..
c Copper Tubes (brazed)	per lb.	9¼d.	..
c ,, ,, (solid drawn)	per lb.	9¾d.	..
g Copper Bars (best selected	per ton	£74	..

METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec.
g Copper Sheet	per ton	£74	..
g ,, Rod	per ton	£74	..
e ,, (Electrolytic) Bars	per ton	£64	..
e ,, ,, Sheets	per ton	£80	..
e ,, ,, Rod	per ton	£74	..
e ,, ,, H.C. Wire	per lb.	8d.	..
f Ebonite Rod	per lb.	3/8	..
f ,, Sheet	per lb.	8/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	4/8 to 4/9	dec.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	44/6	1d. dec.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	..
g Lead, English Ingot	per ton	£12 10	2/6 dec.
g ,, ,, Sheet	per ton	£13	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£8 2 6	2/6 dec.
d Mica (in original cases) small	per lb.	6d. to 1/9	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p ,, rolled bars & rods	per lb.	1/- to 1/3	..
p ,, ,, strip & sheet	per lb.	From 1/1	..
o Platinum	per oz.	£4	..
p Silicium Bronze Wire	per lb.	9d. to 11d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£128 10 to £129 10	..
g ,, Foil	per lb.	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/7	..
p White Anti-friction Metals—"White Ant" brand	per ton	£12 to £62	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5½d.	..
j ,, 2 ply 10 lbs. Russian	per lb.	4½d.	..
j ,, 10 lbs. Russian, single	per lb.	4½d.	..
j ,, 180 lbs. Jute rove	per ton	£11	..
k Zinc, Sh's (Vieille Montagne bnd.)	per ton	£25 5	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

	Locality.	Week ending	Receipts for the week.		No. wks.	Total to date.		Miles open.	*
			£	£*		£	£*		
Tramways & Electric Railways	Aberdeen	Apr. 23	1,230	+302	47	56,516	+11,544	10	—
	Birmingham	,, 23	5,450	+650	17	88,060	+ 4,858	8½	—
	Bournemouth	,, 20	1,165	+215	52	52,445	—	10½	—
	Blackburn	,, 22	889	+ 83	4	3,794	+ 104	13½	—
	Blackpool	,, 21	556	+193	3	2,531	+ 66	8½	—
	,, —Fleetw'd	,, 23	313	+ 18	17	3,984	— 326	7½	—
	,, —Lytham	,, 21	298	—	25	4,434	+ 3,845	7½	—
	Bolton	,, 24	1,794	+ 42	4	6,591	— 252	25	—
	Bradford	,, 16	3,661	—761	9	9,876	+ 464	20	—
	Brighton	,, 24	844	+118	—	3,189	—	7½	—
	Bristol	,, 22	5,076	+599	—	—	—	28	—
	Devonport	,, 15	495	+ 32	15	6,989	+ 954	5	—
	Dudley—Sto'rb'ge	,, 15	725	—464	15	11,446	+ 334	18½	—
	Gateshead	,, 15	884	— 90	15	13,075	+ 618	10½	+ ½
	Gr'n'k—Pt. Glsgw	,, 15	564	+ 11	15	7,075	+ 624	7½	—
	Hartlepool	,, 15	946	— 40	15	3,763	+ 344	6½	+2
	Oldham—Ashton	,, 15	498	—193	15	7,569	— 526	8	—
	Potteries	,, 15	1,593	— 32	15	24,760	+ 1,841	28½	—
	Southport	,, 15	286	— 149	15	3,841	+ 231	5½	—
	South Staffs.	,, 15	732	—385	15	11,341	+ 176	21½	—
	Swansea	,, 15	504	— 96	15	7,067	+ 201	5½	—
	Wolverhampton	,, 15	927	—235	15	5,171	— 288	10½	+8
	Yorks. Wool Dist.	,, 15	668	+283	15	7,939	+ 8,930	6	—
	Miscellaneous	,, 15	2,293	—	15	32,448	—	—	—
	Burnley	,, 23	1,035	+303	—	—	—	10½	+3½
	Burton-on-Trent	,, 24	318	—	38	12,639	—	8½	—
	Cardiff	,, 21	572	+159	16	8,354	+ 1,449	8·68	—
	Chatham & District	,, 21	442	+ 6	16	6,846	— 185	9	—
	Dover	Apr. 23	195	+ 19	16	2,895	— 141	8	—
	Dublin	,, 23	4,917	+ 399	17	70,685	+ 738	47	+ ½
	East Ham	,, 23	753	+ 165	—	2,566	+ 220	5	+ ½
	Glasgow	,, 23	14,936	+1642	47	639,625	+59,239	70	+5½
	Halifax (2 weeks)	,, 20	2,554	—440	3	4,226	— 39	33	+2½
	Huddersfield	,, 23	1,237	+180	2	—	—	28	—
	Hull	,, 23	2,026	+389	3	7,030	+ 497	12½	+1½
	Ilkeston	,, 20	149	—	—	7,678	—	4	—
	Ipswich	,, 21	408	—	3	1,929	—	9	—
	Isle of Thanet	,, 23	428	+ 42	16	4,601	— 395	10½	—
	Leeds	,, 23	5,893	+645	—	23,269	+ 1,821	41	—
	Liverpool	,, 16	9,964	—156	16	153,547	+ 3,116	108	—
	London C. C.	,, 23	10,923	+2483	3	36,751	+ 7,560	32½	—7
	Manchester	,, 23	11,700	+359	3	35,194	— 219	131½	—
	Newcastle	,, 23	3,486	+611	—	—	—	17	—
	Portsmouth	,, 22	1,774	+371	—	6,621	+ 564	14½	—
	Salford	,, 18	3,942	+568	—	19,482	+ 481	80	—
	Sheffield	,, 25	4,556	+514	4	19,610	— 157	32½	+4½
	Southampton	,, 21	949	+ 85	—	—	—	25½	—
	Southend-on-Sea	,, 20	277	+ 51	3	877	+ 63	6½	—
	Sunderland	,, 24	1,170	—332	15	4,059	— 115	20	+8
	Tyneside	,, 13	281	—332	15	4,908	+ 523	8·9	+ ·4
	West Ham	,, 21	754	—	8	3,559	—	4·56	—
	Wolverhampton	,, 20	551	+ 33	—	—	—	7·563	—
Railways	Cen. London Rly.	,, 23	6,538	— 535	17	117,930	— 1,078	6	—
	City & S. Lon. Rly.	,, 24	2,775	—193	17	52,422	— 1,864	6½	—
	Dublin—Lucan Rly.	,, 24	127	+ 33	17	1,632	+ 81	6½	—
	L'pool Overh'd Rly.	,, 24	1,618	— 18	17	26,360	+ 142	6½	—
	Mersey Railway	,, 23	1,429	+ 377	16	29,295	+ 5,794	4½	—

* Compared with the corresponding period of 1903.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"Memo" writes:—"I supplied Mr. A. with a motor on the hire-purchase system, and fixed the same with coach screws. The property belonged to Mr. A., but he had a mortgage on it. An instalment became overdue, and then Mr. A. made a deed of assignment in favour of his creditors. I offered the creditors to allow the motor to remain if they paid the two remaining instalments which were then due, and they agreed. Then the mortgagee stepped in, took possession of the premises, and also claimed the motor as a fixture. I refused to admit his claim and removed the motor.

"Is his claim a good one? If so, what authority have Corporations to spend the ratepayers' money on such a risky speculation as hiring out motors?"

*** It is difficult to answer the above query without reference to the terms of the mortgage under which the mortgagee claims to be entitled to seize the motor. Until all the instalments are paid under the usual form of hire-purchase agreement, the person who lets an article retains the legal property therein. It would therefore seem that unless the motor had become annexed to the freehold so as to form part thereof, our correspondent was entitled to claim it. But had it become part of the freehold? Looking at the cases which have frequently arisen between landlord and tenant, it would seem that this important point is not by any means free from difficulty, and lack of space prevents our going into it with any elaboration. Suffice it to say that in the case of a *tenant*, engines and boilers have been deemed to be removable, that is to say, they can be removed by him at the end of his tenancy. In the circumstances we think that "Memo" was well advised to remove the motor.

As to the position of a Corporation we would remind "Memo" that by Sec. 25 of the Electric Lighting Act, 1882:—"Where any electric lines, meters, accumulators, fittings or apparatus belonging to the undertakers are placed in or upon any premises not being in the possession of the undertakers for the purpose of supplying electricity under this Act, or any license order or special Act, such electric lines, meters, accumulators, fittings, works or apparatus shall not be subject to distress or to the landlords' remedy for rent of the premises where the same may be *nor to be taken in execution under any process of a court of law or equity*, or any proceedings in bankruptcy against the person in whose possession the same may be." The words in italics would seem to afford sufficient protection to Corporations.

INSTITUTION OF ELECTRICAL ENGINEERS.

DIRECT-READING MEASURING INSTRUMENTS FOR SWITCHBOARD USE.

By Kenelm Edgcumbe and F. Punga.

(*Abstract of Paper read in London, March 24th, 1904.*)

Accuracy is of paramount importance, not only in the instrument itself, but under working conditions. A voltmeter, for example, may be accurate to $\frac{1}{10}$ per cent. when tested, but may read 5 or 10 per cent. wrong on a switchboard. The great difficulty met with in the design of electrical measuring instruments is the smallness of the forces dealt with. The principal errors to be guarded against are:—Mechanical errors (*e.g.*, friction), electrical errors (*e.g.*, hysteresis), errors of calibration (*e.g.*, inaccurate engraving of scale), and errors of reading (*e.g.*, parallax).

According to W. Marek, in the *E.T.Z.*, instruments of the highest class, with mirrors under the pointers, are liable to:—Errors of reading, ± 0·07 mm.; frictional errors, less than 0·1 mm.; calibration errors, 0·05 to 0·1 mm.; total error (not electrical), 0·1 to 0·2 mm. The scale is assumed to have been about 5 in. long. In switchboard instruments, the error is probably more than five times as great.

The electrical errors in various types of instrument are, roughly, as follows:—

Type.	Hysteresis.—Difference between up and down curves.	Temperature. Error due to 10° C. change.*	Frequency.—Difference of reading from 40 ~ to 60 ~.	Stray fields.† Error due to bar with 1,000 amps. at 1 m. from instrument.
Direct Current.—Per cent. of Maximum Reading.				
Moving-coil voltmeter	Nil.	·01	—	·2 } In cast-
„ ammeter	„	·75	—	·2 } iron case.
Moving-iron voltmeter	1	·5	— }	1·0 unshielded
„ ammeter	„	Nil.	— }	·25 shielded
Hot-wire voltmeter ...	Nil.	75 } For short	—	Nil.
„ ammeter ...	„	1·5 } periods.	—	„
Alternating Current.—Per cent. of Maximum Reading.				
Moving-iron voltmeter	—	·5	1·0 }	1·0 unshielded
„ ammeter	—	Nil.	·5 }	·25 shielded
Hot-wire voltmeter ...	—	·75 } For short	Nil.	Nil.
„ ammeter ...	—	1·5 } periods.	„	„
Induction voltmeter...	—	·5	4	·5
„ ammeter ...	—	1·0	15	·5

* In many cases the passage of the current itself will cause a much greater rise of temperature than 10° C., and hence a correspondingly increased temperature error. This is particularly the case with moving-iron voltmeters.

† In the case of alternating currents the stray field is assumed to have the same periodicity as the current or voltage which is being measured.

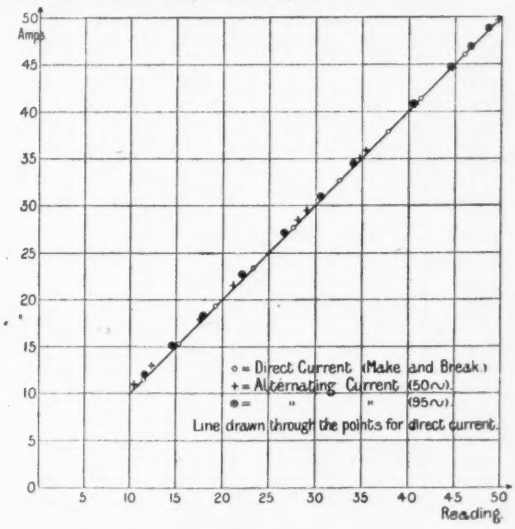

Amps
Reading
o = Direct Current (Make and Break)
+ = Alternating Current (50 ~)
● = " " (95 ~)
Line drawn through the points for direct current.

Fig. 1.

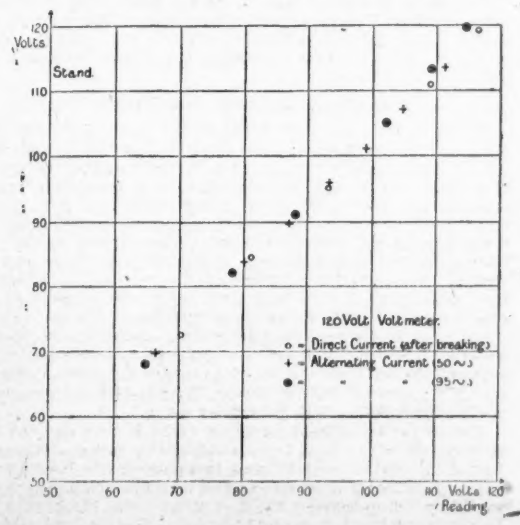


Fig. 2.

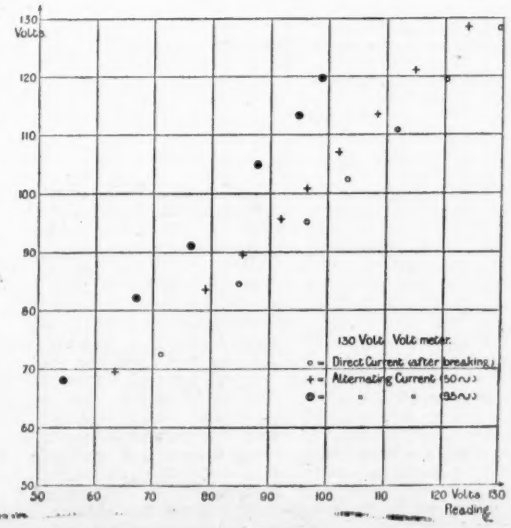


Fig. 3.

And the power-consumption at the maximum reading :—

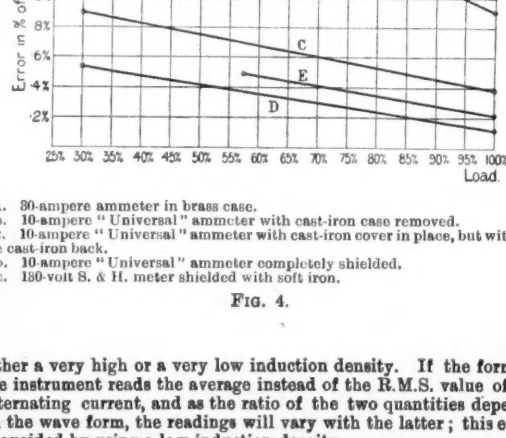
Type of instrument.	Current taken by voltmeters.	Voltage-drop on ammeters.	Watts.
Moving-iron voltmeter, 10 volts	·2 amp.	—	2
„ „ 100 „	·06 „	—	6
„ „ 200 „	·05 „	—	10
„ „ 500 „	·04 „	—	20
„ ammeter, 10 amp.	—	·3 volt	3
„ „ 100 „	—	·03 volt	3
„ „ 500 „	—	·007 to ·01 volt	3·5 to 5
Moving-coil voltmeter, 0 to 200 volts	·01* amp.	—	2
Moving-coil voltmeter, 100 to 200 volts	·02* „	—	4
Moving-coil ammeter, 500 amp.	—	·08* volt	40
Hot-wire voltmeter, 200 volts	·17* amp.	—	34
„ ammeter 500 amp....	—	·2* volt	100
Induction-type voltmeter	Transformers usually employed		5 to 8
„ ammeter			5 to 8
Dynamometer type—			
Voltmeter, 200 volts...	·05 amp.	—	10
Ammeter, 100 amperes	—	·5 volt	50

* The same coil winding is as a rule employed for all ranges, so that these values are independent of the actual range.

The permanent magnet moving-coil voltmeter is probably as perfect an instrument from an electrical point of view as could well be desired. The power consumed is small, the temperature coefficient negligible, hysteresis absent, the control reliable, and the magnets permanent to a very high degree. The action is also dead-beat. In the case of moving-coil ammeters, owing to the necessity of shunts, the temperature error may be from 0·05 to 0·2 per cent. per degree C. An ingenious method has been devised by Mr. Albert Campbell, wherein a four-armed bridge with alternate arms of different metals is used, giving practically perfect compensation. A resistance with an artificially-produced negative temperature coefficient may also be used.

The earth's magnetic field appreciably affects unshielded moving-coil instruments, and they also affect one another considerably if not kept apart; the ordinary cast-iron case appears to be an efficient shield for switchboard instruments. Thermo-electric effects may cause errors of as much as 2 per cent. of the maximum reading of moving-coil ammeters.

Moving-iron instruments suffer from hysteresis, which causes direct current meters to read lower with a rising than with a falling current, and lower with alternating currents than with direct. The path of the magnetic flux in the iron should be relatively short, and the length of the iron short. The error may also be reduced by using



A. 30-ampere ammeter in brass case.
B. 10-ampere "Universal" ammeter with cast-iron case removed.
C. 10-ampere "Universal" ammeter with cast-iron cover in place, but without the cast-iron back.
D. 10-ampere "Universal" ammeter completely shielded.
E. 150-volt S. & H. meter shielded with soft iron.

Fig. 4.

either a very high or a very low induction density. If the former, the instrument reads the average instead of the R.M.S. value of an alternating current, and as the ratio of the two quantities depends on the wave form, the readings will vary with the latter; this error is avoided by using a low induction density.

Frequency and wave-form have different effects on instruments whose readings are not dependent on the square of the current. According to Benischke (*E.T.Z.*, 1901), in the case of an instrument consisting of a long solenoid into which a thin iron wire, highly saturated, was sucked, the effect of frequency was negligible, but a flat-topped wave gave readings more than 12 per cent. higher than a peaky wave. In a well-designed instrument this error should not exceed 1 per cent. Fig. 1 (p. 721) shows the results obtained with a 50-ampere Everett-Edgcumbe "Universal" ammeter of the moving-iron type, which has very low induction density and hysteresis fig. 2 shows the results for a voltmeter of similar type, in which the self-induction is very small, while fig. 3 relates to a voltmeter of another make, which is considerably affected by changes of frequency and wave-form. The cramped character of the scale of moving-iron instruments at the lower end is a drawback in the case of ammeters, but on the other hand, the upper portion of the scale can be enormously opened out, a decided advantage in the case of voltmeters.

The effect of shielding instruments for switchboard use is shown in fig. 4, which represents the errors caused by a bus bar carrying 1,000 amperes at a distance of 1 m. from the instrument, in the position of maximum effect.

The effect of currents in bus-bars depends upon the direction of the bars and of the axis of the coil; in the "Universal" instruments the axis of the coil is parallel to horizontal bus-bars, which therefore have no disturbing effect upon the readings. Positive and negative bus-bars and conductors should be kept close together to minimise stray field errors.

Damping moving-iron instruments is very difficult; liquid damping is unsatisfactory, and magnetic damping (by eddy currents) is unsuitable. Air damping requires great delicacy of workmanship, but is otherwise effective and durable, and has been adopted by Messrs. Everett, Edgcumbe & Co.

(*To be concluded.*)

VISIT OF THE STUDENTS OF THE I.E.E TO ENGINEERING WORKS.

Following the example of their seniors, the student members of the Institution of Electrical Engineers for several years past have paid visits to works and factories connected with electrical undertakings. This year Birmingham was chosen as the centre, the date of meeting being April 11th.

Willans & Robinson, Rugby.

On the way to Birmingham, the engine works of Messrs. Willans and Robinson, at Rugby, were visited. The leading features of these works are the interchangeable system of manufacture adopted and the extreme accuracy of the work, which have assisted much in making the name of the Willans engine famous in the annals of electric lighting. The test room is a very essential feature in a works building prime movers for electric lighting dynamos to the rigid specifications which are at present enforced, so that the well-equipped test house here attracted much attention. All engines are tested under the required conditions of load, being coupled either to the generators they are intended ultimately to drive, or to spare machines kept for the purpose. The losses in these dynamos being easily determined, the B.H.P. can be obtained in a very accurate manner from the voltmeter and ammeter readings. Very careful arrangements are made for the accurate weighing of the condensed steam and other necessary measurements.

Experiments are now being carried out with forced lubrication, the splash system, as is well known, having been the standard method for lubricating this type of engine up to the present time; other radical alterations are also under consideration. Messrs. Willans & Robinson are now in addition developing other prime movers; a new gas engine of the vertical type was being run on its preliminary trials on the test bed, and several steam turbines of an improved type were in the course of manufacture. The petrol engines for the Duryea automobiles are now built at these works—an instance indicating how important the motor car industry is becoming, when an engineering firm of long-standing experience and repute, finds it worth its while to manufacture the motors. A notable advance in prime movers which is also being experimented with, is a combined steam and sulphur dioxide engine, the exhaust steam from the steam cylinders being used to vaporise the sulphur dioxide, which then expands and does work in another cylinder. This, of course, is not a new idea, but, although a good many inventors have been engaged on it, no commercially successful engine has yet been built.

Upon arrival at Birmingham the party were received by the Chairman of the Local Section of the Institution of Electrical Engineers (Mr. Vaudrey) and Dr. Sumpner, of Birmingham Technical College. In their address of welcome they gave the students much useful information concerning the works they were about to visit.

The General Electric Co.'s Witton Works.

On April 12th, the new works of the General Electric Co. at Witton were first visited; these are laid out on modern principles, with the various buildings at ample distances apart, allowing plenty of room for any further extensions that may possibly be required, the power required, of course, being distributed from a central power station. The motors used throughout the works are wound for a terminal pressure of 460 volts, the voltage at the power station being about 500. The distribution is by overhead conductors. Several 75-H.P. motors are in use, and also a number of smaller sizes, all having been built by the company themselves. Group driving is adopted for the smaller machines and independent driving for the larger. The power house equipment consists of one 150-KW. Galloway-G.E.C. set (the dynamo being arranged with tappings off the armature and slip-rings to give three-phase alternating currents); also one 150-KW. Davey, Paxman-G.E.C. steam dynamo and a 50-KW. Belliss-G.E.C. auxiliary set.

The unique department in these works is that devoted to the manufacture of arc light carbons and battery carbons. Gas coke is first of all crushed and reduced to a powder, mixed with graphite and a special binding compound, and then rammed into a cylindrical mould by a drop hammer, the dimensions of the blocks thus formed being about 9 in. diameter by 14 in. long. The material, which is in

a plastic state, is then put into a hydraulic press and forced out through a nozzle containing a die of the correct shape. This nozzle is arranged for heating by steam or cooling by water according to the exact composition and treatment required by the material being worked upon. Upon issuing from the press, it is, of course, a continuous rod; this is deftly cut by hand, as it comes out, into convenient lengths of about 4 ft., inspected, and then packed in an iron case, which in its turn is put inside a special crucible, the interstices being filled with powdered carbon; a cover is then luted on, and the whole placed in a gas-fired annealing or carbonising furnace, where it is raised to a temperature of 2,700° C. A very ingenious form of pyrometer is used by the workmen to determine the correct temperature. It consists of four pieces of porcelain of tusk-like shape made of a carefully graded mixture of china clay, so that when certain temperatures are reached each loses its rigidity in turn and bends over. These pieces are fixed in a piece of fireclay and put in a furnace where they can be seen through a sight-hole, and, according to the number which are bent, the temperature of the furnace can be judged.

In the dynamo and motor shops a large number of alternating current motors were in course of construction, embodying the well-known G.E.C. features, amongst which may be noted the method of attaching the armature stampings on to the spider by aid of a curved wedge fitting into a groove on the outside edges of the spider, also the way in which the leads to the slip rings are brought through the hollowed-out shaft, so that the slip rings can be mounted outside the bearing.

In the afternoon the party went to Wednesbury to see the power station and sub-stations of the Midland Electric Power Co., Ltd., and the rotary converter station of the Wednesbury Corporation, which obtains its supply from the Electric Power Co. and re-distributes it.

(*To be concluded.*)

DYNAMO AND MOTOR TESTING.

By PROF. C. F. SMITH, Wh.Sc.

(*Abstract of Paper read Thursday, March 3rd, 1904, before the Civil and Mechanical Engineers' Society.*)

(*Concluded from page* 684.)

Efficiency Tests of a Dynamo.—The methods of determining the efficiency of a dynamo alone are of two kinds:—(1) Methods in which the driving power and the electrical output are both separately measured. These may be called the *direct* methods; (2) methods in which the losses occurring in the dynamo are determined by electrical measurements. These losses, when added to the output of the dynamo, give the power supplied to it. These are the *indirect* methods of measuring the efficiency.

Direct Methods of Measuring Efficiency.—Practically the only difference between the various tests of this class lies in the method of measuring the power supplied to the dynamo.

If the dynamo is driven directly by an engine, it would suffice to know the power exerted by the engine. This is, however, not easily determined. The work performed in the engine cylinder can be

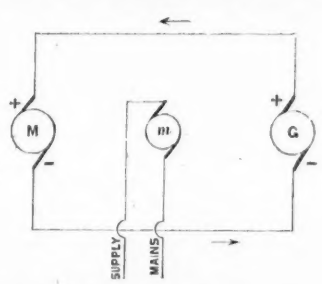


Fig. 4.

estimated from indicator diagrams with a moderate degree of accuracy. The mechanical efficiency of the engine can be approximately determined by a further experiment, and in this way the power given to the dynamo may be estimated.

The method cannot be considered satisfactory where it is the efficiency of the dynamo alone which is to be determined, and not the efficiency of the combined plant.

Dynamo Driven by Motor of known Efficiency.—The power supplied to a motor when doing work is very easy to measure. If the efficiency of the motor is known, the power exerted by it is capable of easy and exact measurement. If such a motor is used to drive the dynamo to be tested, the driving power and electrical output can be measured with equal accuracy.

The driving motor may be tested for efficiency by the usual brake test. The test must be carried out with the motor working under as nearly as possible the same conditions as when subsequently driving the dynamo. The motor may also be tested by one of the indirect methods described later.

The method of coupling the dynamo to the motor may introduce an error of which it is difficult to determine the magnitude.

If the shafts of the machines are rigidly coupled together, increased friction in the bearings is almost certain to result.

The best method of coupling is to connect the shafts through a flexible coupling, the driving force being transmitted by leather links or india-rubber springs, so that a slight relative motion of the shafts is always possible, and the friction on the bearings of either

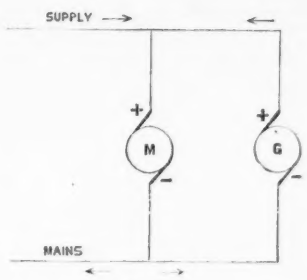


Fig. 5.

machine is neither increased nor decreased by the shaft of the other, since each bearing is allowed to take the full weight of its own shaft.

Where frequent tests have to be made on similar machines, the simplest method is often to couple the machines in turn to a motor whose efficiency has been carefully determined and recorded in the form of curves applicable to all the speeds and loads required.

Methods of Absorbing Power.—In the case of small dynamos the output is absorbed in resistances which usually take the form of frames of iron-wire coils. These frames should be kept in a well ventilated shed outside the test-house. Light wooden frames with ordinary galvanised wire netting stretched upon them make a very inexpensive but rather bulky form of resistance. A water resistance may also be used.

In test houses, specially equipped for the frequent testing of large generators, arrangements are always made for usefully employing the current generated whenever possible.

Large machines when tested in couples only, require the supply of the small amount of power necessary to make up the losses occurring in them, even when tested upon full load.

If the dynamo is to be motor-driven during the test, it is often possible to adopt a method similar to that employed in the Hopkinson method of testing dynamos, as in fig. 4.

Indirect Methods of Measuring Efficiency.—Since the power supplied to a dynamo is the sum of its useful output and the power lost in the dynamo, it is sufficient, in order to determine the efficiency, to make measurements of the output and of the lost power. Efficiency per cent.

$$= \frac{\text{Useful power given out}}{\text{Power given out} + \text{power lost}} \times 100.$$

Two Coupled Machines Connected in Parallel.—Various methods of supplying the additional power have been suggested; the following method of connection to an external source of current will in general be found the most convenient. It is practically the method proposed by Kapp.

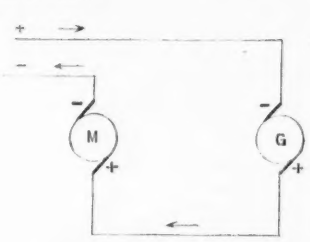


Fig. 6.

The machines are connected in parallel with each other to power mains giving voltage equal to that of the dynamos running at normal speed (fig. 5).

The output of the dynamo is measured by an ammeter and voltmeter, and is supplied direct to the motor. The power supplied from the mains is similarly measured. The power given to the motor is thus the sum of the dynamo output and the power supplied from the mains. The combined efficiency of the two machines is $\frac{\text{output of dynamo}}{\text{input to motor}}$. The joint efficiency of the two machines is the product of the efficiency of each machine.

Since the machines are of the same type and size, their efficiencies should be approximately equal.*

* This will not be exactly true, even in the case of two machines which are absolutely identical, since the efficiency of a machine when operating as a motor will be less than when working as a generator. Also the excitation of one of the machines is below the normal. The error introduced by this fact would make the efficiency of the machines appear slightly lower than its true value when working as dynamos. In most cases this error would be negligible.

Accordingly, it may be assumed that the efficiency of either is the square root of the combined efficiency determined by the experiment.

Thus, efficiency of each machine $= \sqrt{\frac{\text{output of dynamo}}{\text{input to motor}}}$.

It should be noted, in connection with this method of testing, that the loss of power is measured directly, and is a quantity of small dimensions compared with the output of the machines under test. Consequently, an error of small percentage made in this measurement will be exceedingly small compared with the output of the machines, and will only affect the value of the total efficiency to a correspondingly small extent.

In carrying out the test, the machines are connected to mains giving approximately the normal voltage of the machines, and the power representing the losses is obtained by measuring the current taken from the mains.

Two Coupled Dynamos Connected in Series.—Experiments in which machines are coupled together, so that one machine supplies part of the power required to drive the other, may be carried out in a

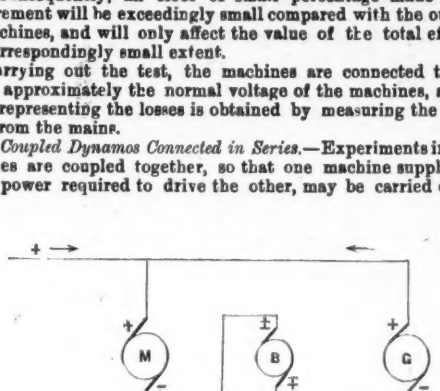


Fig. 7.

considerable number of other ways. Another method may be mentioned, which, although not so easy to carry out as that just described, may be made to give more reliable results in the hands of a capable observer.

In fig. 6 the two armatures are connected in series, and this extra power is supplied in the form of current equal in amount to the output of the generator, but at a lower voltage. In the previous experiment the machines were coupled in parallel instead of in series, and the extra power consisted of a supply of current at practically the same voltage as that of the machines being tested, but small in amount.

The connections for the experiment are shown in (fig. 6), the machine M acting as a motor to drive the machine G, which acts as a generator and contributes to the supply of power given to the armature of M. It will be seen that the two armatures are connected in opposition, brushes of the polarity (marked + in the figure) being joined together.

In consequence of this method of connection, the − brush of the generator G is shown to be connected to the + terminal of the source of supply. The generator is thus connected in series with the supply source in such a way as to add its voltage to that of the source. Consequently the voltage available at the terminals of the machine M is the sum of the voltages of G and of the source of supply.

Fig. 7 again shows three machines which are all mechanically driven by each other through belt gearing.

The two machines G and M are the generator under test, and a motor driven direct from the power mains respectively. The third machine B is a booster inserted in the circuit between the generator and motor in order to adjust the generator voltage to the value required by the motor.

The amount by which the booster alters the generator voltage is adjusted by a rheostat in the booster field, and the sense in which the voltage is altered is determined by the direction of the exciting current. If the generator gives a voltage lower than that of the motor and supply mains, the booster is driven by the motor and adds its voltage to that of the generator so that the current generated becomes effective in driving the motor. If, on the other hand, the generator volts are higher than those of the supply, the booster is made to act negatively, and to oppose the E.M.F. of the generator so that again the current supplied to the motor is at the correct voltage. In this case the booster acts as a motor, and will assist mechanically in driving the motor M.

Motor Testing.—It is most usual for motors to be loaded when under test by being coupled to a dynamo, the output of the dynamo being either absorbed in resistances, returned to the mains, or supplied to the motor in one of the methods detailed above.

The output of the motor in such cases is obtained by measuring the amperes and volts supplied by the generator, the efficiency of which must be known. In this way the output can be measured on delicate instruments with the same accuracy as the power supplied to the motor. This method is more convenient than the use of absorption brakes, which are generally considerably more trouble to apply to the motor and require a supply of water for cooling.

When brake tests have to be made on the customer's premises or elsewhere, the form which is generally the handiest for such high speeds as those of electrical machines is that of a flexible band of webbing or cotton rope, from one end of which load weights may be conveniently hung, while the other end is attached to a spring balance secured to a fixed point of support. In order to damp small vibrations of the needle of balances of circular pattern, the author has attached to the spindle of the needle a brass disc, the inertia of which has been effectual in securing steady readings.

Where the adoption of a special pulley with internal rim for water cooling is not possible, as is frequently the case where tests are to be conducted on motors *in situ*, tests of power developed can only be taken for very short periods until the pulley becomes overheated, and time must then be allowed for the pulley to cool between successive readings. As a rough guide of the power which can be absorbed from a pulley of a given size without overheating, the following approximate rule may be used:—If

b = breadth of pulley in inches,
d = diameter " "
H.P. = horse-power to be absorbed,

then $b\,d$ = H.P. × 23·5 for air-cooled pulleys,
or $b\,d$ = H.P. × 4·7 for water-cooled pulleys.

With specially high speeds, and, consequently, light surface pressure, these values for $b\,d$ may be slightly exceeded.

Magnetic brakes have been introduced in certain cases with considerable success. In these brakes, electro-magnets acting upon the rim of a pulley and fly-wheel induce eddy currents in the rim. In consequence of these eddy currents, and the hysteresis of the material of the wheel, a retarding pull is exerted, and the energy driving the wheel is converted into heat in the material of the rim.

THE FARADAY SOCIETY.

An ordinary meeting of the Faraday Society was held on Wednesday, April 13th, at the Institution of Electrical Engineers. Mr. J. Swinburne, Vice-President, was in the chair.

Mr. Arthur J. Hiorns read an abstract of his paper on "Alloys of Copper and Arsenic," illustrating his remarks by a series of interesting lantern slides. The object of the author's investigations was to ascertain the exact relation between copper and arsenic in binary alloys, and the limiting proportion of arsenic that can be retained in copper in the cold solid state.

Mr E. G. P. Bousfield contributed a paper on "Experiments with a New Primary Cell." The cell consists of an inner porous pot containing nitric acid and a carbon pole, and an outer vessel containing a metal pole, preferably zinc, and sodium hydrate solution, *i.e.*, a solution of from 12 per cent. to 15 per cent. Using solutions of maximum conductivity with zinc and carbon poles, on open circuit an E.M.F. of 2·6 volts may be obtained. Not only does the cell possess this comparatively high E.M.F., but it may be short-circuited far longer than most cells before it runs down. A cell short-circuited through a total resistance of 0·61 ohm gave a current of 4·18 amperes, which fell to 2·61 in an hour, 2·38 in 2½ hours, and 1·75 in 6 hours. A smaller cell gave a fairly constant current of about 0·8 ampere for 20 or 25 hours. Discharge curves are given in the paper.

Acids other than nitric were experimented with. Some of them gave higher E.M.F.'s than nitric acid, but no other acid possessed the same "lasting powers." The effect of using various metals instead of zinc was also tried; some of these gave higher E.M.F.'s than the zinc, but the high readings were quite transitory. Using two carbon poles, the E.M.F. was about 1·35 volts. The cell is then similar to Becquerel's platinum cell, in which the plates are immersed in acid and caustic potash respectively.

Mr. W. R. Cooper referred to the disadvantages of both nitric acid and caustic soda as electrolytes. The high E.M.F. of the cell was only apparent because it rapidly fell to a working value of 1·8 or 1·9. He would like to have seen comparative tests made, say with a bichromate cell.

Mr. J. Swinburne mentioned a suggestion made by Dr. Swan that the cell would be improved if it were converted into a three-fluid cell, with a neutral electrolyte (*e.g.*, $NaNO_3$) in the mid-compartment.

Mr. Bousfield also contributed a "Note on Determining Accurately the Percentage of Ozone in Gases not dissociated by Moderate Heat.' The method recommended by the author is a measurement by volume. A certain quantity of gas containing ozone is passed over some substance such as heated platinised asbestos, which is capable of converting ozone into ordinary oxygen. On again measuring the gases, an increase of volume due to the breaking down of "O_3" molecules into "O_2" molecules is found, from which the percentage of ozone originally present is readily calculated.

"PROTECTION" FOR THE POSTMASTER-GENERAL OF AUSTRALIA.

Hitherto Australia has been behind the British times in the matter of regulations respecting the supply and distribution of electricity for traction and lighting; for, in a land where Protection blooms, the Postmaster-General finds himself insecurely protected from "shivering shocks" and the confusing effects of induction and leakage. Only in 1901 did he obtain an Act enabling him to make such regulations, but the need for them cannot have been of extreme urgency, for the draft set now under notice was issued not earlier than October last year.

It is the fate of all regulations to be criticised and condemned by those whose actions it is sought to regulate, and it would be especially remarkable were any Governmental mandates of this, or of any other nature, to pass without dissection of the most searching

order. So we find mayors and councillors, and occasional engineers, representing all the interested districts of Australia, present at a commiuatory conference at Melbourne in January this year; the tangible result being a counterblast to the "Draft Regulations" in the shape of "Recommendations," which seem in chief to recommend that any particular regulation shall be omitted, or cruelly mutilated at the least. This is not complimentary to our Board of Trade, whose statutory rules and orders are incorporated for the most part; and, if only to see what we can do to whitewash the body that has done so much to protect us from ourselves and from our neighbours, whether we would or no, we ought to examine these decimating recommendations.

Taking them as a whole, we think that the Conference has protested too much; and we say this while we religiously exclude any thought of the time when we, too, had fine bushy tails, somewhere before '97.

For instance, the request is made in many instances that the words "the property of the P.M.G.," shall be interpolated, or added to regulations dealing with the protection of pipes and wires, although the draft states distinctly that "These regulations apply only to those places . . . . in which the wires or works of the P.M.G. are, or may be, injuriously affected by the lines or works of any electric authority."

Nevertheless, there are several regulations which the most flexible imagination can hardly stretch to cover protection to the lines and works of the P.M.G.; and, although they may be, and often are, sound regulations from the point of view of the citizen, they should not be included in a draft issuing from the Postmaster-General's department.

Objection is taken to the "continuous indication" of current from the earth plates, and of fall of potential along the rails.

In the first case, the Conference proposes closing the recording instrument circuit twice daily for five minutes on each occasion; and in the second case, it thinks a 24-hours' record every month quite sufficient.

Considering the automatic nature of the recording apparatus, and the very small amount of attention required to ensure its working properly, we think the objection trivial, and, with regard to the fall of potential records, unsound; for there are light and heavy days on every traction system, and on any line where the maximum permitted fall is exceeded regularly on certain days, it is reasonably certain that records would not be taken on any of those days.

Neither have we any sympathy with the proposal to increase the permitted "drop" from a maximum of 7 volts for a line of any length to 3½ volts per mile. Undoubtedly the cost of complying with the existing B. of T. regulation becomes very large when heavy services are run, but the depreciation of other people's property has to be considered just as much as the augmentation of capital charges on the tramway; and, although we do not believe that appreciable damage is done to pipes or other ironwork under the 7 volts limit, yet sufficient evidence exists in America, and even in Britain, to prove the destructive effects of drops ranging above 15 volts.

It is difficult to see why the P.M.G. should object to sections of overhead line more than ½ mile in length, or why he should insist on means being provided for isolating each section for purposes of testing. The original B. of T. regulation called for sections no longer than ¼ mile, but nobody observed it. However, we have not been allowed to exceed the ½ mile; and most men will agree that such a length is about right for practical purposes, although shorter sections are useful in busy centres. The Conference thinks that the ½-mile proposal is not good practice; but we think it would have been wiser to have relied on the second objection that "it is a matter outside the scope of these regulations."

The original regulation as to leakage, its amount, testing and removal, is annexed bodily by the P.M.G. of Australia. So far as the maximum leakage allowed is concerned, the figure of ½ ampere per mile of tramway is generous, but it is time that the insistence on a daily test should be excised. When the clause was born, tramways were small affairs which went to sleep for 8 or 10 hours out of each 24, and there are still tramways galore on which no difficulty is experienced in taking daily leakage tests; but we quite agree with the opposition in the present case when they say "that such a test would be impossible in many instances." Nevertheless, we do not go all the way with the opposition, for they suggest the entire omission of the demand for tests at any specified intervals of time, as they consider that the private requirements of the tramways "would necessitate the maintenance of the standard of insulation proposed," and that the method of complying should be left to the tramway authority. Of course, if everyone were perfect, there would be no need for regulations of any kind, but the limitations of human nature frequently make it necessary to bring the good and the less good under one law.

We suggest respectfully to the B. of T. that a weekly leakage test of all lines might be insisted on more forcibly than it would be fair to insist on the execution, to the letter, of the current regulation.

A monthly test of all underground cables, for whatever purpose used, is to show an insulation resistance of not less than 10 megohms. That is our old friend, and the Australian protestants want him strangled.

The B. of T. and the Australian P.M.G. can hardly realise what an undertaking it is to carry out this test conscientiously, especially when there is a difficulty in getting the necessary megohms without disconnecting at every half-mile section pillar. Frequently it is impossible to carry out these tests except at night, and unless the testing staff is out of all proportion to the size of the undertaking, a month hardly contains sufficient non-running or light service hours to complete the tests on the many miles of cable on a 50-mile line.

Cables depreciate in general very slowly, and, although we do not uphold the Conference in its desire to omit every kind of compulsory test, we do believe that quite as high a standard of insulation would be maintained if the interval between tests were lengthened to six months. We believe, too, that the generality of results would be more accurate than at present.

If the Conference had objected to the cable tests on the ground that an insulation resistance of so many megohms had been proved entirely misleading as a practical measure of the factor of safety of the medium protecting the copper from the earth, and had demanded some more valuable and modern method of testing, we should have been with it.

The difficulties in the way of applying a breakdown test in practice on a system of any size are evident to any who give the matter a little thought, but they are by no means insuperable, and the method might conceivably become simpler than the present method, and certainly would be more satisfactory to everyone concerned.

Sparking between "rubbing or rolling contacts," *i.e.*, between trolley-wheel and wire, or between car-wheels and rails, has, at first sight, no conceivable effect on the wires or works of the P.M.G., yet the two B. of T. regulations with relation to this sparking have been included. When sparking at either place occurs, currents of more or less magnitude are being broken, or partially broken, many times per second, so that there might be an inductive effect felt in parallel wires; but, if there is, then the ordinary working fluctuations would be felt just as seriously. We agree with the Conference that Clauses 16, 17, and 18, as to the working and maintenance of the rolling stock, are superfluous.

It is very interesting to note that at this point the Australian proposed regulations jump right into guard wires, whereas the English original lays down the law as to the working of conduit lines. Does this mean, we wonder, that the P.M.G. has sufficient faith in the commercial intelligence of the inhabitants of his country to know that they will not build conduit lines while they can get the most satisfactory results out of the trolley?

The explanatory note prefacing the proposed regulations as to guard wires is all that is excellent, and embodies the main heads of our teaching for years past. We should like to have seen something on the same lines at the head of the revised regulations issued by the B. of T.

The note says that the best protection of telegraph wires is afforded by the following means:—(*a*) By putting them underground; (*b*) by bunching in lead-covered cable suspended by earthed bearing wires; (*c*) by earthed guard wires.

It is impossible to avoid the use of guard wires at present, but they certainly should be set last in order of efficacy, as they are above.

Then the P.M.G. suggests that "points of crossing of telegraph wires . . . . should be as few as possible, at right-angles to the trolley wire," and where more than 10 wires cross he undertakes to cable them.

Following the new matter comes practically the whole text of the last B. of T. pronouncement, with the important addition of a quarterly test to prove the efficient earthing of all guard wires. No maximum resistance to earth is mentioned, but, as in England, it must be low enough to ensure that a short-circuit caused by a wire bridging the guard wire and trolley wire shall open the circuit-breaker. That is an impracticable requirement, but the Australians have uttered no protest.

Very few tramways are unfortunate enough to have circuit-breakers guarding every half-mile section, and on the few that have, we have heard that the use of a piece of wood, or a bit of string, to prevent the circuit-breakers acting, is not unknown.

Imagine the plight of a town such as Manchester, or, say, Liverpool, with its endless rings of cars at the landing-stage, if the B. of T. insisted that the circuit-breaker controlling any section must be set to open before a wretched little bit of No. 12 copper wire can be fused on short circuit!

Little objection can be raised to the B. of T. or a Colonial P.M.G. stipulating that the resistance to earth of any guard wires shall not exceed a fixed amount; but, when tramway authorities have complied with that, and have fixed their guard wires in accordance with the other requirements, they have taken ample precautions to protect the other man's wires against dangers which would arise from defective construction or maintenance of his own wires, and they should be no more required to conform with the additional regulation than a railway company is required to run its trains at such a speed that they can be pulled up in time to avoid killing every lunatic who crosses the track, although they have complied with the regulation as to fencing and notices.

In such cases the broken telegraph wire ("message wires" we christened them once, to include telephone wires and telegraph wires in a less arbitrary way than that adopted by Parliament) must act, and generally does act, very effectually, as its own fuse.

We are quite in sympathy with the Conference in its endeavour to avoid the erection of guard wires in any case, on the grounds that they are not efficient as guards, but are a positive source of danger in themselves; but we consider rather squeamish its objection to them on the ground of unsightliness, when so much of the distribution of electricity for all purposes is done by means of aerial wires and cables.

We agree with the Conference in thinking that a trolley-pole coming into contact with guard-wires, and—if it is to be—pulling them down, or causing them to be burnt down, is not a matter about which a P.M.G. need concern himself; but it certainly lies within the scope of the B. of T. to make a regulation to the effect that stops shall be fitted to prevent trolley-booms rising high enough to foul the guard wires. Unfortunately, this is ofttimes a counsel of perfection on account of the widely varying heights of the trolley wire; but we believe that a little more attention to this point would reduce one of the most dangerous classes of accident.

The Conference is bold above all when it takes objection to keeping—at least, for the information of a Government department—any of the records to which all English tramways are accustomed. It says that "the requirement to furnish such periodical records of the working is an unnecessary and objectionable interference with the management of the tramways, and outside the legitimate scope of these regulations." That is strong, but, we take leave to think, not too well founded. Although we are slaves ourselves, we should like to see others free, but we cannot overcome our conviction that, even to the P.M.G., it is of some importance that the current from earth connections, leakage current, fall of potential in return, and other similar conditions should be divulged when occasion seems to call for such information. Even the maximum working pressure record is useful to him, if only to prove that no falling message wire can be charged to a highly dangerous potential. The Australians will be lucky if the section relating to records is deleted.

Division B. of the proposed regulations deals with electric light and power lines or works. It contains 23 sections, which have been smitten by the Conference as follows: 12 are to be excised, 6 others are to be mutilated, and, in all, objections are raised against 20.

The P.M.G., following the English model, seeks to stipulate a minimum size of wire; no single conductor to be less than No. 14, and no single wire of a strand to be less than No. 20. Objection is raised on the ground that the size of a conductor cannot affect the P.M.G. in any way. This might be granted so far as underground wires are concerned, but where aerial lines are to be used, the P.M.G. feels anxious to know that they will be strong enough not to break and fall on to his wires, which would be an infringement of his prerogative! Exception should be taken to the desire of the P.M.G. to make this regulation retrospective, and it should be distinctly worded so as to exclude underground cables.

Without a doubt Regulation 23 should be cut out. It would require every high-pressure conductor to be continuously insulated with a minimum dielectric thickness of $\frac{1}{10}$ in., while after 2,000 volts (E.H.T.) "the thickness of insulating material shall not be less in inches or parts of an inch than the number obtained by dividing the number expressing the volts by 20,000." The Cable Makers' Association ought to have something to say to this. It is the original and obsolete English regulation, and should not have been inserted in a new code.

If by any chance the regulation could be enforced, an effectual check would be given to E.H.T. transmission. The Conference evidently thinks that the regulation refers to aerial lines as well as to underground lines, but we hardly think it possible. Can anyone imagine a 40,000-volt transmission line strung on insulators, and covered with dielectric (to say nothing of protective coverings) to a depth of 2 in.?

The Conference also objects with reason to two regulations providing for the use of quick-acting cut-offs to protect high-pressure (includes E.H.T.) lines and transformers.

Another section makes it imperative on a light or power supplier to obtain the sanction of the P.M.G. to connect to earth. This would be a most vexatious and irksome requirement. There have been enough discussions about the rights and wrongs of earthing to have made it possible for any Government to draft special rules covering all conditions. Doubtless, they would not suit everybody, but everybody would be suited much better than by the proposed regulation, which has no counterpart in the English code.

In a country where lightning storms are more severe and more frequent than in England, it seems strange that nothing equivalent to our Regulation No. 14 is included in the draft.

The lack of originality, or of adaptability to altered conditions, on the part of the Australian Government, is to be noticed much more in Division B. than in the Traction Division. The rules governing maximum intervals between supports of aerial lines; the erection and construction of the supports, and the attachment of aerial lines, are to be identical with those made for use in this country at a time when telegraph lines were about the only aerial lines in existence, and when the Legislature quaked at the idea of pressures exceeding 300 volts. Some distinction must be made now between lines running over inhabited areas, and lines striking across country for long distances. In the former case a 200-ft. span is as long as is desirable, but a considerable increase may be allowed in the latter; in fact, it *must* be allowed unless, as the Conference points out, the erection of long cross-country lines is to be prohibited.

The question of earthing metal poles carrying H.T. or E.H.T. lines is one of great interest, and we should like to have more fully the reasons of the Conference for objecting to the stipulation to this effect transplanted by the P.M.G. from our rules. They say that it is generally impracticable and endangers the safety of the employés, but we should say that its non-observance would be a grave menace to the safety of the public. Nevertheless, as the Australians have had more experience than ourselves in this direction, we are open to conviction.

Now that such tremendous tensions are being carried or proposed, it is not surprising to find the Conference requesting that the clause laying down that the distance between "lead and return" (rather a vague description where polyphase transmission is in view) shall not exceed 2 ft., shall be modified to a stipulation that they shall be on the same pole; and it is for this reason that we think the Conference illogical in trying to halve the clear distance of 24 in. which the Minister wants between his wires and transmission wires.

Our previous remarks on the subject of the incorporation of obsolete regulations apply to that relating to the suspension of every aerial line by insulating ligaments from bearer wires. The Conference brings to the notice of the Minister the fact that the President of our Board of Trade has stated in Parliament that the regulation would not be pressed. That fact should be within the knowledge of the Australian Government, and we do not think that they will enhance their dignity as law-givers if they insist on retaining regulations which they do not mean to enforce.

The strongest opposition should be brought against the Minister's intention to forbid the use of the air to any other person or body, if his department's wires already occupy positions on either or both sides of the street. No Government can validly claim sole right of user of public roads, and a prohibition of the above nature would work immense mischief if permitted to endure.

Anyone with a reasonably active imagination can picture not only unnecessary and undesirable, but inequitable, losses and complications arising out of the last proposed regulation in Division B, which seeks to enforce that a leakage on a consumer's premises, which interferes with the department's lines, shall be followed by the immediate disconnection of the consumer and the discontinuance of supply until the *department's officers* are satisfied that the leakage has been removed. Naturally, this forms one of the clauses to which exception is taken.

The Conference gives no thanks to the Minister for his proposals as to the cost of works for the protection of his lines, but it raises only points of legal interest by way of objection. These proposals seem to be perfectly fair, and come, we are ashamed to say, in the nature of a surprise; for we are not accustomed to Postmasters-General in this country wanting to pay for anything if they can bluff someone else into doing so. The Australian Minister is more generous, and will pay for replacing single-wire circuits by metallic circuits when induction troubles arise.

On the other hand, costs incurred in circumventing stray currents arising from tramways will be a charge on the tramways; but, in the matter of guard wires, the P.M.G. having previously defined the correct positions in certain cases, not only of the electric authority's wires, but of his own as well—something which, we believe, no English Regulation hitherto has done—now admits his sole liability to put into a legally correct position any of his wires which require such treatment.

Moreover, when the P.M.G. intends to put his wires underground, although that action may "meet the convenience of the electric authorities," he will not force them to pay the whole, or a large proportion, of the costs, but will bear the cost himself; and "the cost of carrying out works for the protection of the telegraph lines of the P.M.G. shall be borne by him where such lines have been erected subsequent to the works of the electric authority."

Looking at the proposed Regulations as a whole, they do not seem to be either onerous or extravagant in their demands. They are based on the English Regulations, which themselves are by no means perfect or up to date; but many clauses have been omitted, and some have been improved. While no harm ever came of hearty, root-and-branch opposition of the kind offered by the Conference convened by the Lord Mayor of Melbourne, we incline to think that more good might result if some of the objections were withdrawn.

We have to thank Mr. H. R. Harper, city electrical engineer of Melbourne, who has not been a colonist many years, for sending copies of the Draft Regulations and the Minutes of the Conference.

THE MEASUREMENT OF ELECTRICAL CONDUCTIVITY.

By J. RYMER-JONES.

THE conductometer—fully described in the ELECTRICAL REVIEW of October 9th, p. 601—was designed by Mr. R. Appleyard to facilitate measuring the copper conductivity per cent. of a great number of hanks required for cable conductors. It differs from the ordinary *metre-bridge* in the following essential respects:—(1) It has a so-called "conductivity scale"—on which are graduated percentages from 95 to 105 and intermediate decimal sub-divisions—which may be so set and permanently clamped to the right or left of the electrical middle of the bridge wire (marked 100) as to correct for any difference between the conductivity per cent. of the wire used as a standard of comparison and Matthiessen's pure copper wire taken as 100. (2) There is another "diameter scale" divided into tenths for 2·5 per cent. on either side of the zero graduation at the middle of this scale, which slides against, and parallel to, the conductivity scale.

The contact slider can also be clamped at any required percentage graduation along this *diameter scale* to compensate for a difference in diameter between that of the standard wire, and each of the wires successively balanced against it.

After making these two corrections, the sliding contact is adjusted in the usual way, and when balance is obtained the conductivity per cent. of the wire under test is read directly off the conductivity scale.

The advantage of the "conductometer" over the simple "metre-bridge" (Diagram 1) is not very apparent, because—assuming for the present that ganging is a reliable index of

Name of Cable..... Order No.....

Diagram 2.

Weight of strand conductor per nautical mile = 107 lbs. [six wires around one]
" single " = 15·22 lbs. — straight wire —
Diameter of { Outer wires = 28·741 mils; S.W.G. = 22; weight per 30 ft. = 525·1 grains (g); increase in length due to 1¼ in. lay = 0·53 per cent.;
{ Inner wire = 26·741 " " = 525·1 " minimum conductivity specified = 98 per cent. purity.
Resistance per naut. pound = 1,204·5 standard ohms at 75° F.
Maximum resistance of conductor per nautical mile at 75° = 11·3113 standard ohms { Outer wire per nautical mile at 98 per cent. = 79·131 standard ohms.
{ Centre wire " = 79·134 " "
Weight in grains per 30 ft.—with the *true* conductivity per cent. below—of hanks underlined in the same column.

							5·1																								
									511 / 99·7		513 / 99·8	518 / 99·2	521 / 99·3	521 / 99·9	522 / 100·1	526 / 100·5	529 / 99·8	523 / 100·2	533	534 / 100·4	535	536 / 100·5	539 / 100·2							
									517·2		518·5	519·8	521·1	521·8	522·8	526·4	529·0	527·7	529·0	530·3	531·6	536·9	538·2	539·5	540·9	542·2	543·5	544·8	546·1	A	
									½		⅜	99	¼	¾	100	¼	½	½	⅜	101	¼	½	¼	⅛	103	½	½	⅜	101	B	
									496·3		496·9	497·5	498·1	498·7	499·4	500·6	501·8	501·2	501·8	502·5	503·1	507·6	506·3	507·0	507·6	508·3	508·9	509·6	510·2	C	
							6		12		3 / 8	9	1	15 / 16	7	10	2	15	4 / 41	14 / 24											
							73		27		21	17	32	13 / 16	22	20	23 / 31	42 / 43	44	26											
									79		39	30 / 33	38	25	34	35	49 / 54	47	45	36											
									81 / 82		59	88	83 / 85	63	46	50	53 / 58	64	60	75											
									89		73	90 / 92	87	80	55	53	69	66	61												
											76			93	57	58			68												
															70	65	71	67													
															64																

if the weight and purity of another wire combine to give a resultant of 98 per cent. on the metre-bridge, and gauging shows this wire to be 1 per cent. lighter than the standard, it is obvious that its *measured* conductivity would be 1 per cent. greater were its weight 1 per cent. greater (*i.e.*, as heavy as the standard); consequently the *true* conductivity per cent. will be 98 + 1 or 99 per cent.

The "conductometer," it is true, enables this to be read off *directly* without any addition or subtraction; but since in order to do so the difference in diameter between the standard and test wire must be known *before* balancing, "a list made out of deviations for every tenth of a mil for that gauge," and the diameter scale re-set for every hank; the slight advantage of direct reading had better be sacrificed for less complexity of apparatus and system. Moreover, an additional man is required to gauge and call out the result to the tester, who has, therefore, to wait upon the gauger instead of the testing proceeding uninterruptedly.

Whether the testing be made by the "conductometer" or the ordinary meter-bridge, however, this method is open to the objection that gauging, although doubtless correct in *principle*, may be incorrect in *practice*, especially if the diameter of the wire be very small. In that case a slight error in gauging makes a serious difference in the weight deduced from it. No doubt exceedingly careful gauging can give a close approximation to the relative weights when the zeros of the gauges are frequently checked; ratchet springs press with equal force on the wire; several readings are recorded, and the true mean obtained from them; and, above all, when a strict supervision is exercised over gaugers, who (to save time) are prone to become less careful, and inaccurate gauging naturally entails incorrect results. In the case of a seven-strand conductor of (say) 107 lbs. per N.M., one of the single wires [No. 22 gauge] weighs 15·22 lbs. per N.M., or 525 grains per 30 ft. One per cent. difference in conductivity due to weight is, therefore, represented by a difference of only 5·25 grains, so that it must be very exact gauging to ensure a result closer than 1 per cent. Again, one-tenth per cent. (or 1 mil in 1,000) error, when gauging diameters, represents 0·2 per cent. conductivity, and we are told that "wire as received from the wire drawers may vary in diameter to the extent of 0·5 to 1 per cent. in a length of a few yards." These instances help to show how uncertain diameters are, and what a large number of gaugings should be noted from which to obtain a true mean. It would be dangerous, therefore, to attach too much importance to the laboratory experiment adduced in the description of the "conductometer" as a proof of accuracy for *practical* work in a factory.

It must be borne in mind that the "conductometer" after all only gives the *conductivity* per cent.; whereas, when supplying wire to meet the requirements of a specification, *weight* is as important as conductivity per cent. An error, therefore, in gauging not only affects the measured *conductivity*, but the *weight* also. In short, the system leaves too much to the gauger, and even when the greatest care is exercised, gauging is not so reliable as the generally accepted method of weighing.

To cut and weigh 30 ft. from each hank would, however, mean considerable waste and work. The following system has been in use for many years, and with care enables wire to be supplied quickly and with considerable confidence as to its fulfilling the specified conditions.

(To be concluded.)

NEW PATENTS APPLIED FOR, 1904.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

8,630A, 1903. "Improvements in or relating to dynamos." J. F. McElroy. April 11th. (Date applied for under Patents Rule 9, February 16th, 1903.)

8,245. "The continuous action life-guard for electric tramcars." A. E. Robens. April 11th.

8,258. "Improvements in and relating to apparatus for the control of electrical circuit breakers and like devices." L. Andrews. April 11th.

8,262. "Improvements in and relating to telephones for use in dictating correspondence, for exchange call room, for personal use, and for other like uses." S. J. Port. April 11th.

8,269. "Improvements in electrically-illuminated letters and signs for advertising and the like." G. H. Chard. April 11th.

8,277. "Improvements in or relating to means of charging storage batteries." M. Sutherland, and E. Marcuson. April 11th.

8,294. "Improvements in electrical induction machines, motors, and transformers." H. B. Lippelt. April 11th.

8,297. "Improvements in systems of electrical distribution." P. C. Hewitt. April 11th. (Date applied for under Patents Act, 1901, April 25th, 1903, being date of application in United States.) (Complete.)

8,312. "Improvements in and relating to electrically-driven rotary hair brushes." J. G. Lemon. April 11th.

8,316. "Improvements in or relating to electric machine tools." J. S. Fairfax. April 11th.

8,321. "Improvements in receiving apparatus for use in wireless telegraphy." G. Möller. April 11th.

8,323. "Improvements in automatic electric switches." J. D. F. Andrews. April 11th.

8,332. "Improvements relating to spark plugs." E. van Morse. April 11th. (Complete.)

8,347. "Improvements relating to the fittings for electric conduit, both for lighting and power." T. Taylor. April 12th.

8,356. "Electro-magnetic device for controlling the position of a switch tongue with an electric car or truck." E. Labmuth. April 12th.

8,365. "Storage batteries or accumulators." W. Fairweather. (Vesta Storage Battery Co., United States.) April 12th. (Complete.)

8,378. "An arrangement whereby ordinary house electric bells can be used for electro-medical purposes." A. Page. April 12th.

8,394. "Improved apparatus for automatically operating electric switches, gas cocks, or other like controlling devices." C. Russ. April 12th.

8,398. "Improvements in and connected with electrically energised pendulum clocks." G. D. Granger. April 12th.

8,399. "Improvements in and relating to alternating electric current motors." The British Thomson-Houston Co., Ltd. (The General Electric Co.) April 12th.

8,400. "Improvements in and relating to alternating electric current motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) April 12th.

8,401. "Improvements in and relating to alternating electric current motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) April 12th.

8,402. "Improvements in and relating to alternating electric current motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) April 12th.

8,403 "Improvements in and relating to alternating electric current motors." The British Thomson-Houston Co, Ltd. (The General Electric Co., United States.) April 12th.

8,404. "Improvements in and relating to alternating electric current motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) April 12th.

8,454. "Variable-speed electrical haulage engine." W. Cubitt, C. M. James, and D. L. Selby-Bigge. April 13th.

8,477. "Improvements in incandescent electric lampholders." R. E. Rees. April 13th.

8,501. "Improvements in controllers for the motors of electrically propelled vehicles." M. Cummins. April 13th.

8,514. "Improvements in vapour electric apparatus." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) April 13th.

8,515. "Improvements in vapour electric apparatus." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) April 13th.

8,540. "Improvements in printing telegraph receivers." F. J. Swift. April 13th. (Complete.)

8,549. "Electric ships' telegraph." J. Houston and J. Erskine. April 14th.

8,555. "Improvements in electric stop-motions for drawing, slubbing, and other similar machines for preparing and spinning cotton and other fibrous materials." E. Tweedale, S. Tweedale, and J. Smalley. April 14th.

8,590. "Improvements in brush-holders for dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) April 14th.

8,591. "Improvements in electric switches." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) April 14th.

8,608. "Improvements in commutators for dynamo-electric machines." (Date applied for under Patents Act, 1901, May 22nd, 1903, being date of application in United States.) F. W. Young. April 14th. (Complete.)

8,612. "Improvements in or relating to the transmission of electrical impulses." J. S. Richmond. April 14th. (Complete.)

8,620. "Improvements in and relating to electric motors." T. von Zweigbergk. April 14th.

8,621. "Improvements in and connected with rails for electric tramways, and for like purposes." A. Fowler. April 14th.

8,632. "Improvements in or relating to the decoration of articles by the electro-deposition of metals." W. Kenyon. April 15th.

8,642. "Improvements in or connected with 'trolleys' for overhead electric tramways." A. G. Livesay. April 15th.

8,656. "Improvements in electric arc lamps." F. Proctor. April 15th.

8,657. "Improvements in printing telegraph receivers." J. D. White. April 15th.

8,663. "Improvements in switches for electro-motors." H. G. Jeken. April 15th.

8,669. "The application of a new and improved insulator for use in electric kindred and other trades." D. Gillies. April 15th.

8,686. "An improved galvanic battery." P. Delafon. April 15th.

8,693. "Improvements in or relating to electric arc lamps." Ganz & Co. (Eisengiesserei-und Maschinenfabriks Akt., Ges.) April 15th. (Date applied for under Patents Act, 1901, May 9th, 1903, being date of application in Germany.) (Complete.)

8,694. "Improvements in or relating to alternating current arc lamps." Ganz & Co. (Eisengiesserei-und Maschinenfabriks Akt. Ges.) (Date applied for under Patents Act, 1901, July 24th, 1903, being date of application in Germany.) April 15th. (Complete.)

8,699. "Improvements in and relating to windings for dynamo-electric machines, and in methods of, and apparatus for, forming the same." The British Thomson-Houston Co. (The General Electric Co., U.S.) April 15th.

8,703. "Improvements in electric switches." R. Zwack and L. Kottmair. April 15th.

8,714. "Improvements in electric switches" H. J. Gore. April 15th.

8,715. "Improvements in and connected with electric circuit cut-outs." W. P. Thompson. (C. Johnston and C. Johnston, United States.) April 15th. (Complete.)

8,731. "Improvements in automatic electric circuit-breakers." H. Swanton. April 16th. (Complete.)

8,737. "Improvements in and connected with mechanically-replaced annunciator movements for telephone switchboards." H. Oppenheimer. (Actien-Gesellschaft Mix & Genest, Germany.) April 16th.

8,745. "Improvements in the trolley pulleys of electric tramcars." G. A. Binns. April 16th.

8,777. "An improvement in the attachment of globes or shades to electric lamp fittings." J. S. W. Thomas. April 16th.

8,819. "Improvements relating to incandescent electric lamp fittings." S. Lévi. April 16th. (Complete.)

8,836. "Improvements in safety appliances for electric circuits." Siemens Bros. & Co., Ltd. (Siemens & Halske Aktiengesellschaft, Germany.) April 16th. (Complete.)